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VOLUME 13, NUMBER 4 • APRIL, 1957

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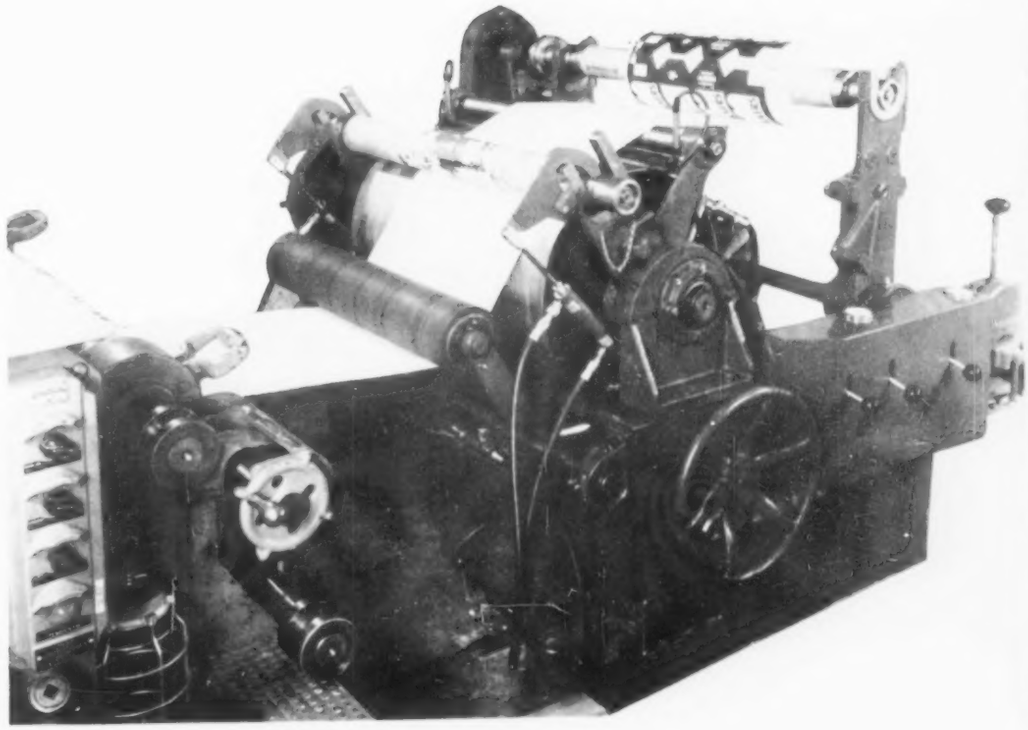
Continuous Plastic Film Winding Machinery

Story on Page 23



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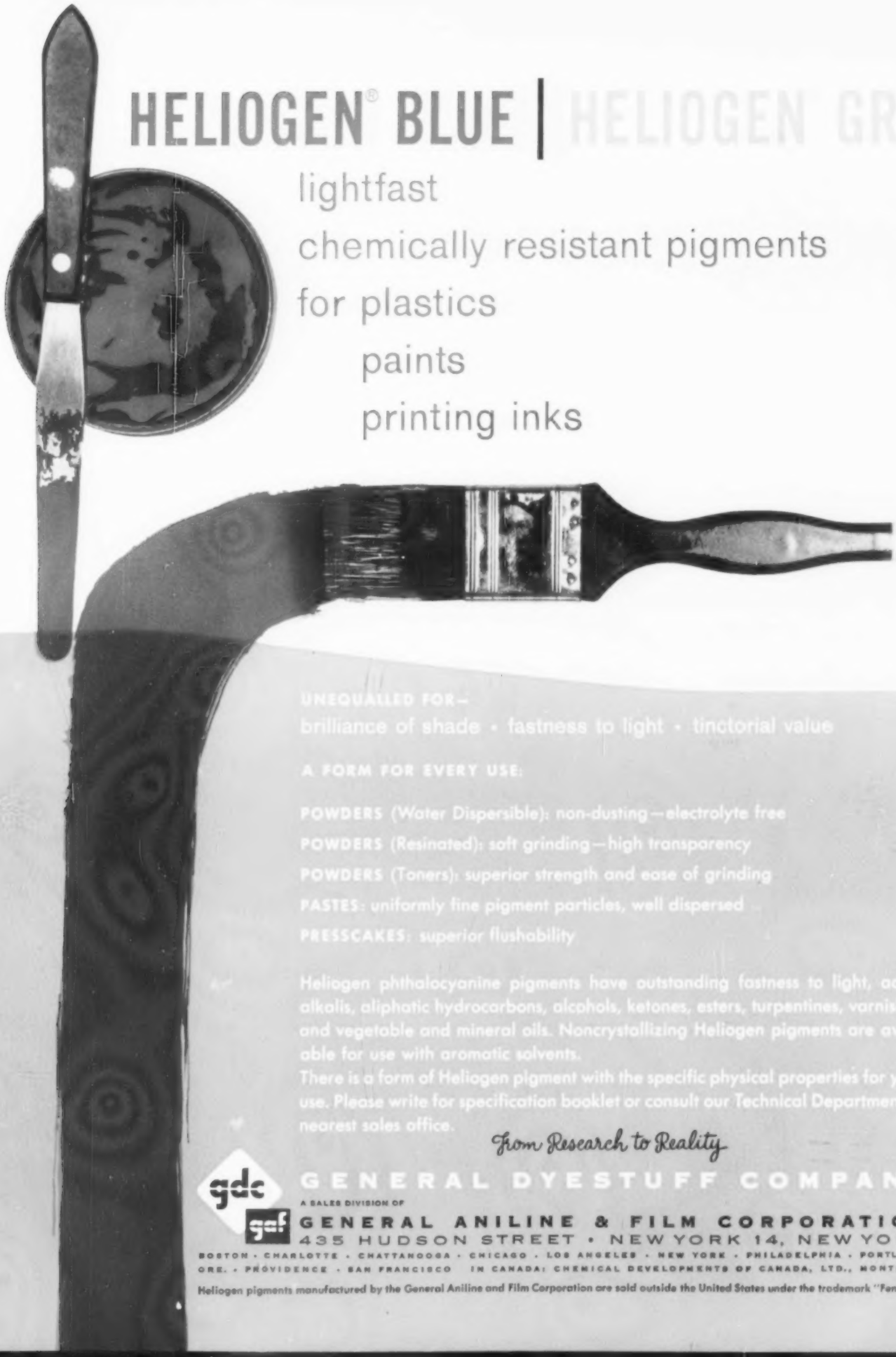

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Vol. II, No. 2

POLYETHYLENE PROCESSING TIPS

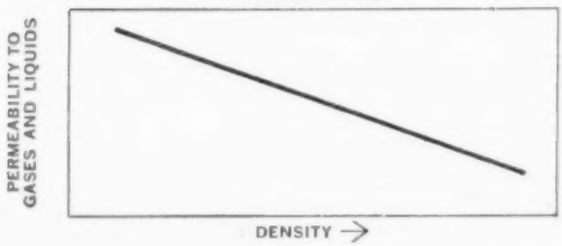
HOW RESIN DENSITY AFFECTS POLYETHYLENE PROPERTIES

The *density* of a polyethylene is one of three basic characteristics which determine the properties of a processed part. The other two basic characteristics are *molecular weight* and *molecular weight distribution*. Relationships among the three were discussed in Tips, Vol. 2, No. 1 (reprints are available).

Polyethylene density can range from 0.910 to 0.965. The graphs below indicate what happens to certain properties as density of the resin increases, assuming the other two basic characteristics do not change.

It must be remembered, though, that these graphs do not give the entire story. Molecular weight and molecular weight distribution are often different in resins of different densities, so the effects of all three must be taken into consideration if the end properties are to be predicted. The effects of these other characteristics on end properties will be discussed in future issues of "U.S.I. Polyethylene Processing Tips".

Permeability



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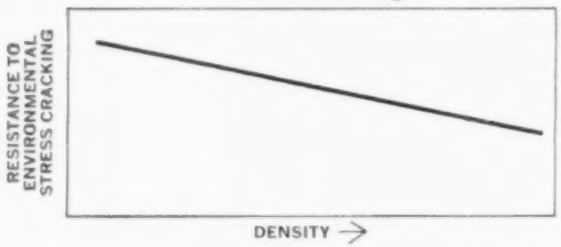
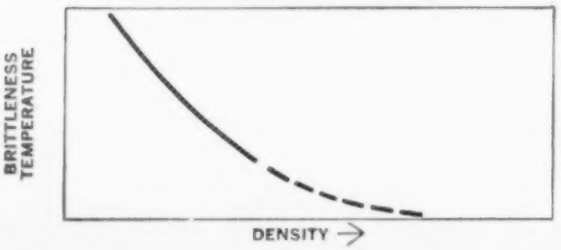
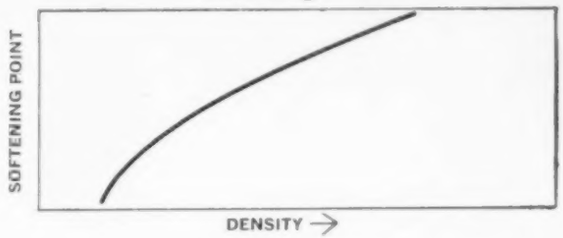


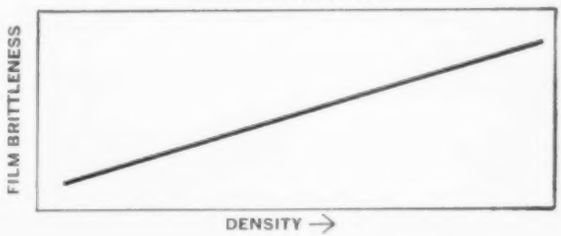
Brittleness Temperature



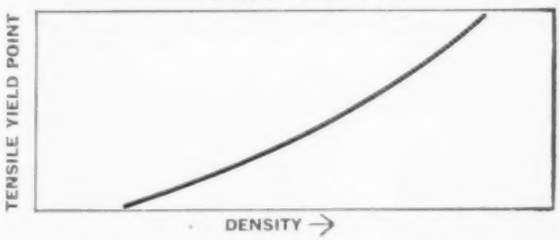
Softening Point



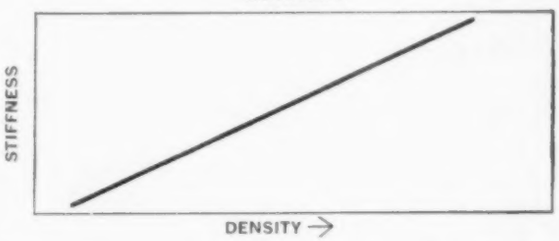
Film Brittleness



Tensile Yield Point



Stiffness



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SPE JOURNAL

Vol. 13 April, 1957 No. 4

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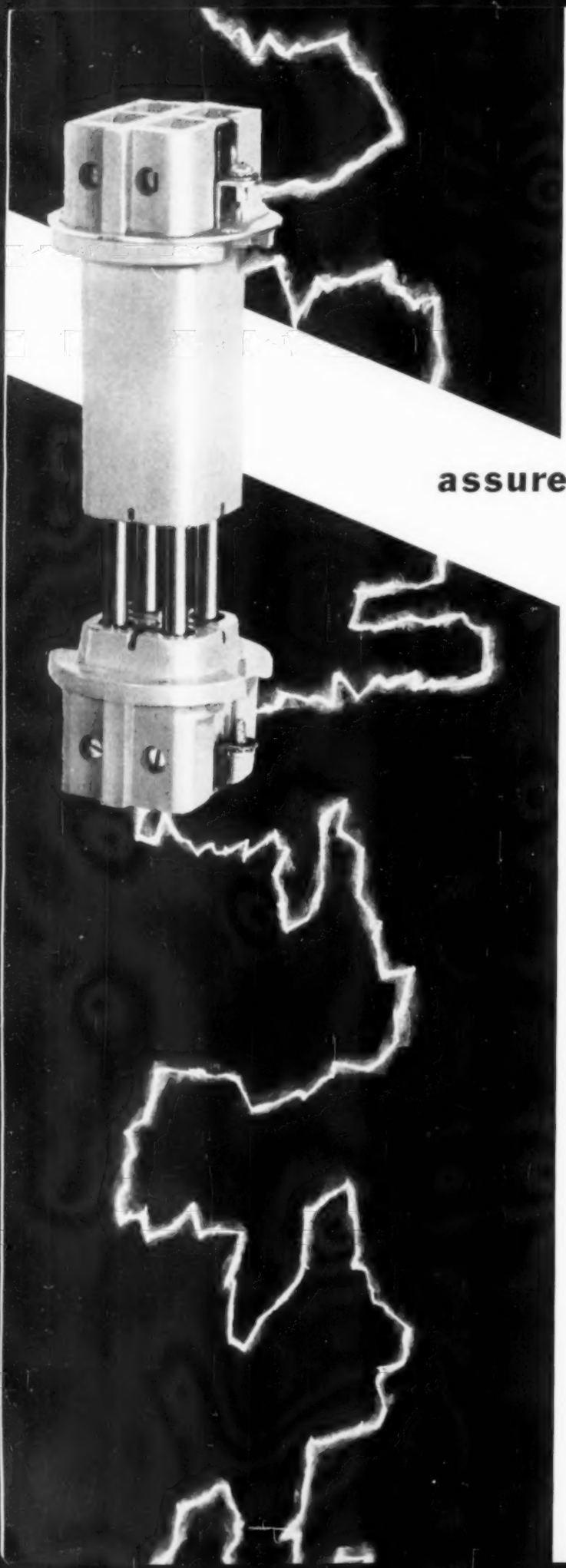

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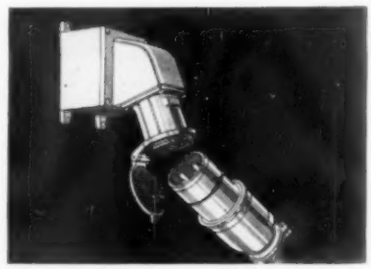

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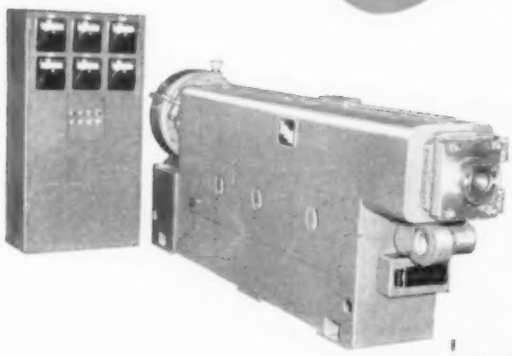

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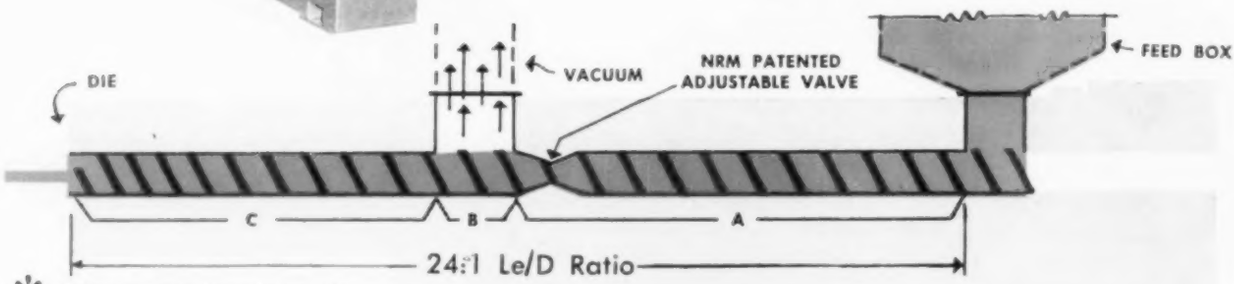

* *Volatile constituents in the plastic causing porosity are "vented" as follows: Plastic is heated, plasticized, and volatile elements brought to evaporation point in stage A. In stage B, plastic releases gases which escape through vent built integral with the cylinder. In stage C, material is further heated and worked, completing the extrusion cycle.*

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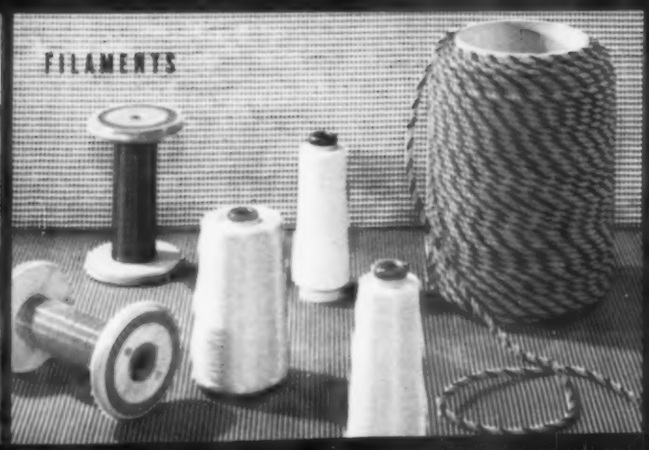

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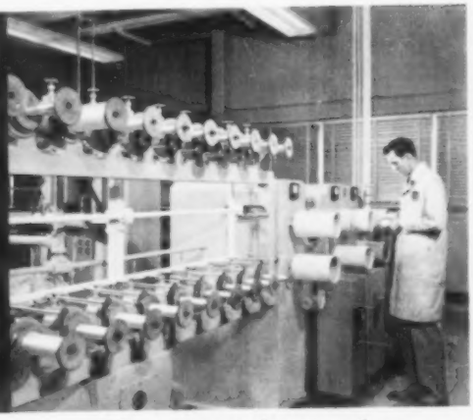

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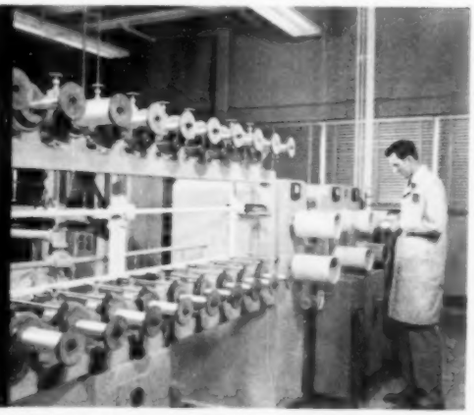

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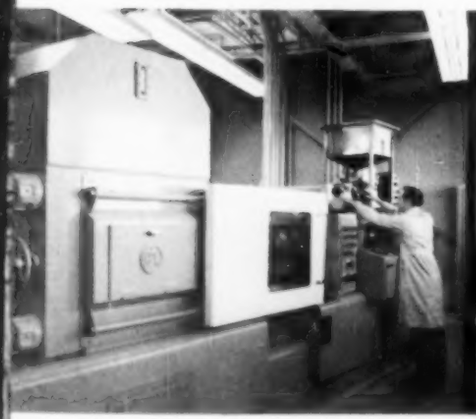

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The "Coffee Master's" phenolic rim is odorless, imparts no taste, and is unaffected by moisture or hot vapor. Chicago Molded Products Corp. used BMG-2095.

BMG-2095 . . . *a chemical-resistant phenolic*

This premium chemical-resistant molding material is also useful where moisture resistance, non-toxicity, and minimum odor are necessary.

It is a one-step, cellulose-filled phenolic with good molding latitude, fast set-up, and good mold release.

Dimensional stability is a notable property of BMG-2095. Surface appearance is excellent. Pieces molded from it will not bleed in most organic solvents. As a result, this material is useful for both industrial and consumer applications.

Handles, base, and switch for the Sunbeam "Coffee Master" were molded of BMG-5000 by Chicago Molded Products Corp.

BMG-5000 . . . *a general-purpose phenolic*

BMG-5000—the outstanding development in phenolics by Bakelite Company—is a truly general-purpose material, matching production efficiency with the broadest possible range of applications.

This means economy. BMG-5000, engineered for the best combination of curing speed and molding latitude, assures minimum down-time. It provides rapid set-up and easy release from mold cavity plungers and followers. Its lower specific gravity increases molded items per pound.

BMG-5000 is suitable for compression, plunger, or transfer molding. Products are rigid at hot discharge, can be released from the mold quickly and easily. An exceptional surface appearance results from the uniform shrinkage and absence of warpage and blisters.

TYPICAL PROPERTIES

Values relating to Fabrication	General-Purpose BMG-5000	Electrical-Resistant BMG-0750	Heat-Resistant BMG-8335	Impact-Resistant BMG-2080	Chemical-Resistant BMG-2095
Granulation (D392-38)	16 mesh	16 mesh	12 mesh	6 mesh	16 mesh
Bulk Factor (D392-38)	2.4	2.2	2.1	3.0	2.6
Plasticity Grades Available	4, 6, 9, 12, 15, 18	6, 9, 12, 15	6, 9, 12, 15	9, 12, 15, 18	4, 6, 9, 12, 15
Molding Shrinkage, in./in. (D955-51)	0.005	0.004	0.004	0.006	0.006
Values from Electrical Tests					
Dielectric Strength (D149-55T) Short time, volts/mil	370	385	150	280	225
Volume Resistivity, ohm-cm. (D257-54T)	1×10^{12}	1×10^{13}	5×10^{11}	1×10^{12}	1×10^{13}
	60 c. 1 kc. 1 mc.	60 c. 1 kc. 1 mc.	60 c. 1 kc. 1 mc.	60 c. 1 kc. 1 mc.	60 c. 1 kc. 1 mc.
Dielectric Constant (D150-54T)	5.7 5.3 4.6	4.9 4.7 4.5	20.0 13.0 8.0	11.0 8.0 6.0	22.0 13.0 7.0
Dissipation Factor (D150-54T)	0.07 0.04 0.03	0.020 0.018 0.008	0.25 0.20 0.08	0.21 0.16 0.05	0.30 0.25 0.06
Values from Mechanical Tests					
Izod Impact Strength (D256-54T) ft-lb./inch of notch	0.30	0.34	0.30	0.48	0.25
Compressive Strength (D695-54), psi	34,000	25,000	28,000	28,000	34,000
Tensile Strength (D651-48) (⅛ in.), psi	8400	7000	5000	7500	7000
Flexural Strength (D790-49T), psi	10,000	9500	7000	9000	7500
Modulus of Elasticity in Flexure (D790-49T), psi	10×10^5	22×10^5	12×10^4	8.5×10^5	8×10^5
Values from Miscellaneous Tests					
Molded Specific Gravity (D392-38)	1.34 1.36	Black 25 Brown 15	1.72	1.68	1.37	1.37
Heat Distortion Temp., deg. F. (D648-45T) (½ in.–264 psi)	330	285	340	315	340
Moisture Sensitivity:					
Water Absorption (D570-54T), per cent wt. gain	0.45	0.03	0.2	0.4	0.4
Saturation Constant, per cent	8	1.1	3	4.8	3.5
Diffusion Constant, $cm^2/hr.$	1.3×10^{-5}	1×10^{-3}	1.5×10^{-5}	3×10^{-5}	7×10^{-3}

Bakelite Company has numerous phenolic compounds in other special categories as typified by:

BMG-0750 . . . *exceptional electrical resistance*

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Its dimensional stability is excellent—an important property where close tolerances must be held. Its moisture resistance equips BMG-0750 for further success in electrical applications. Most of them—vacuum tube bases, coil forms, capacitor housings, and resistors, for example—make use of both these factors. In molding, BMG-0750 demonstrates exceptionally fast set-up. It has lower "fines" content, better mold release, and less tendency to gassing. Improved molding characteristics make it suitable for either compression or transfer molding.

BMG-8335 . . . *superior heat resistance*

For long periods of time, BMG-8335 will withstand temperatures as high as 400 deg. F., even as much as 500 deg. F. for shorter periods.

Pieces molded from it have an exceptional gloss that is retained even after exposure to high temperatures. Color retention is also excellent. Consequently, BMG-8335 is widely used for utensil handles and heating appliance components. This mineral-filled two-step phenolic has a relatively low specific gravity. More items can be molded per pound. Finished pieces are compact and light-weight. In addition, they are resistant to wear and abrasion and are dimensionally stable.

BMG-2080 . . . *high impact resistance*

While the impact resistance of this material is its primary feature, BMG-2080 balances this property with a number of others that are important.

Even at elevated temperatures, BMG-2080 displays superior resistance to moisture, soap, and detergents. It performs extremely well where one side of the molding is wet while the other remains dry. It is widely used for pump housings, valve bodies, fill tubes, aspirators, washing machine agitators, sterilizers, and dispensers. As a one-step material, BMG-2080 also offers several advantages in the molding process, notably minimum odor and a rapid rate of cure.

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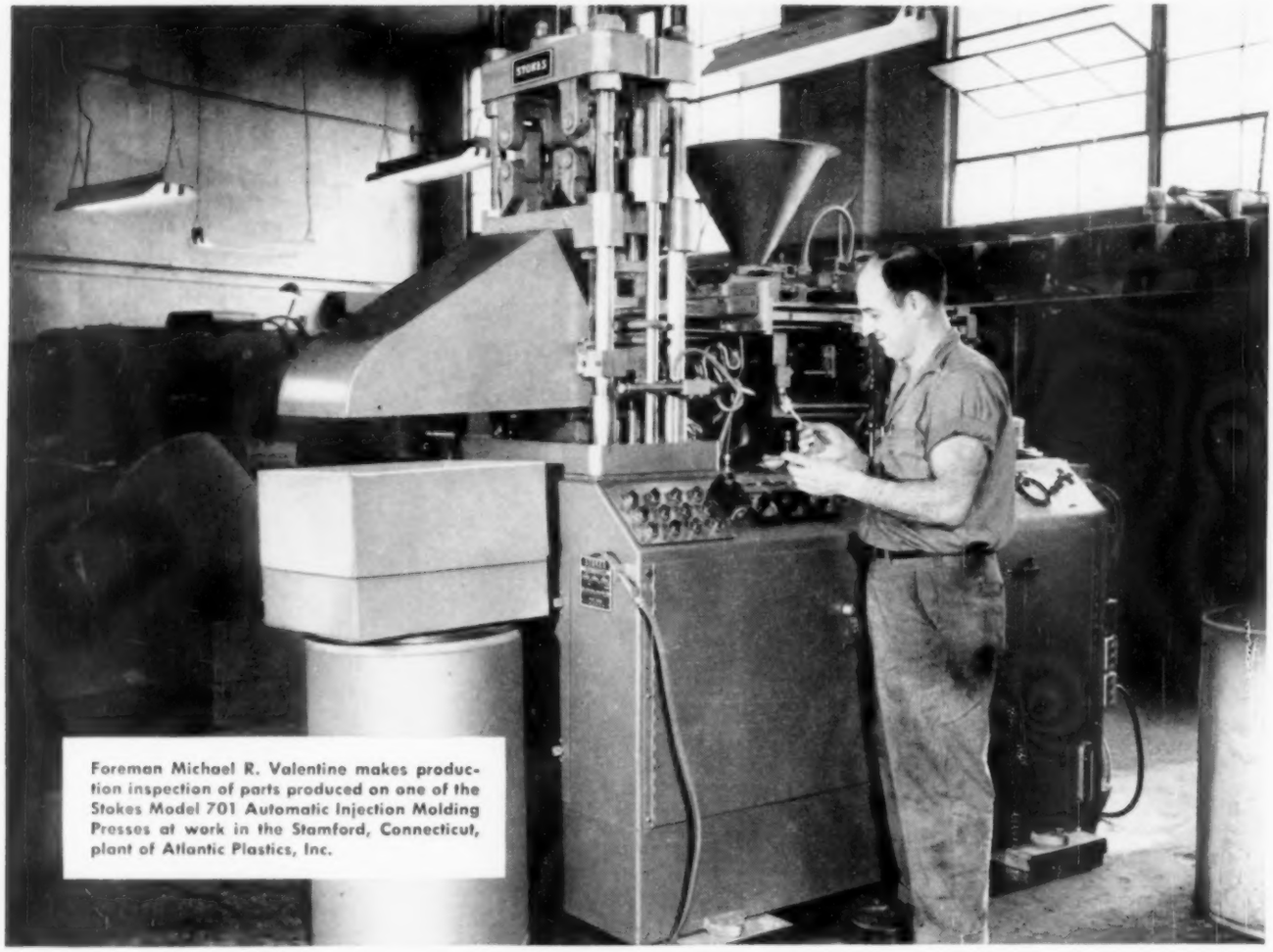

Foreman Michael R. Valentine makes production inspection of parts produced on one of the Stokes Model 701 Automatic Injection Molding Presses at work in the Stamford, Connecticut, plant of Atlantic Plastics, Inc.

Atlantic Plastics Inc., relies on Stokes Model 701 presses

At the Stamford, Connecticut, plant of Atlantic Plastics, Inc., four Model 701 Stokes automatic injection molding presses have been installed and two more are on order. Atlantic Plastics was one of the first companies to successfully mold nylon—and are nationally known today for their ability to handle all types of thermoplastic resins.

Joseph E. Benoit, President and General Manager, when asked why Stokes presses were selected, stated "These machines will help us maintain our reputation for quality molding, while at the same time affording our customers lower prices for the injection molded parts they buy from us".

A major advantage of the Stokes 701 is the simplicity of the tooling. The small simplified mold costs less . . . enables faster set-up and changeover . . . provides higher uniformity and quality of finished product. A 701 can produce lower cost parts through reduced labor, faster cycles, and higher efficiency.

The Stokes patented ejection system positively clears all parts and runners from the die . . . assuring *continuous* automatic operation. Secondary protection is provided by use of the more common low-pressure close. It is a complete, self-contained molding plant. Its vertical design saves floor space . . . permits sorting and separation . . . facilitates mold set-up.

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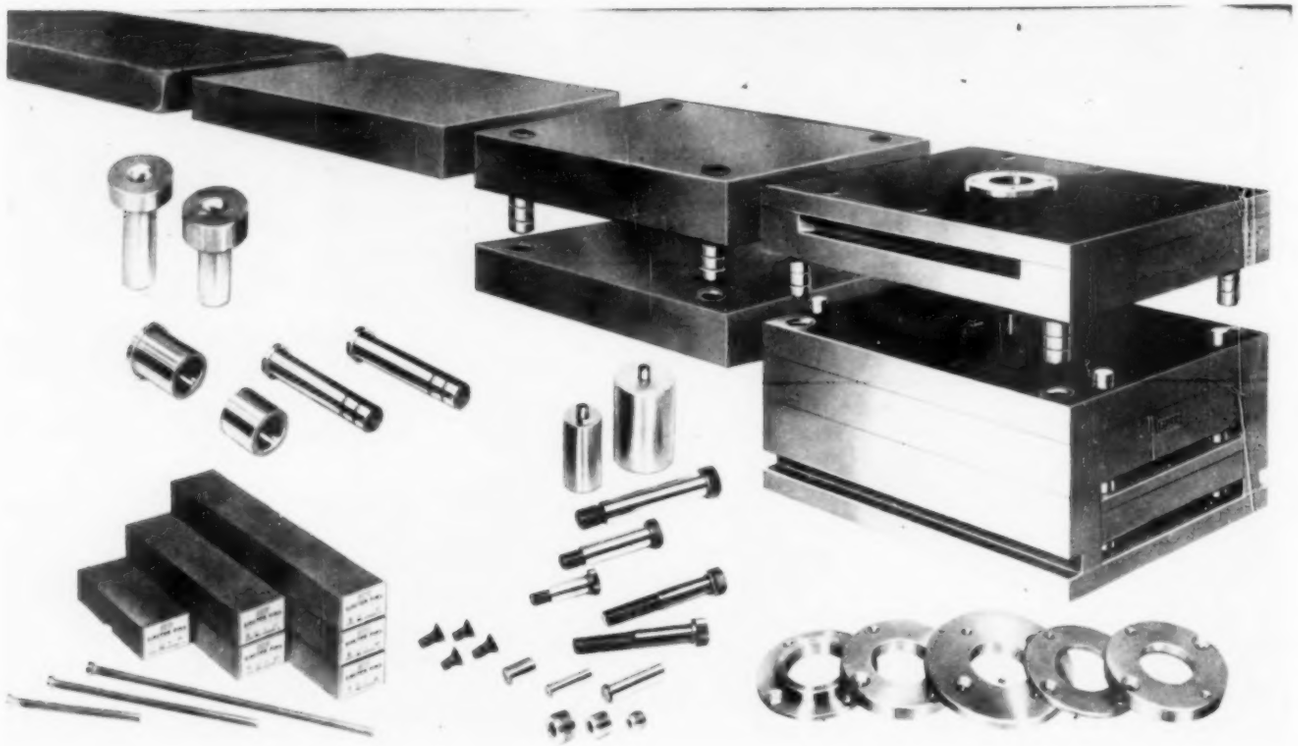

PROGRESS THROUGH STANDARDS

. . . and how DME "helped"

The history of economy in modern business has been directly related to the history of Standardization. One of the major elements affecting the economic production of finished plastic parts is the high initial cost of the mold. A progressive step in reducing mold cost, without sacrificing the high quality required, has been successfully achieved through Standardization.

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Through large volume purchases of quality steel in standard sizes and specialized production facilities, D-M-E was able to produce and supply high quality Standard Mold Bases to mold makers and molders at such great savings in cost and time that the benefits of Standardization were quickly realized by the Industry.

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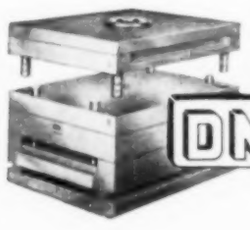

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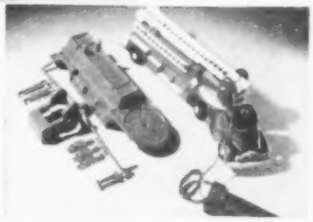
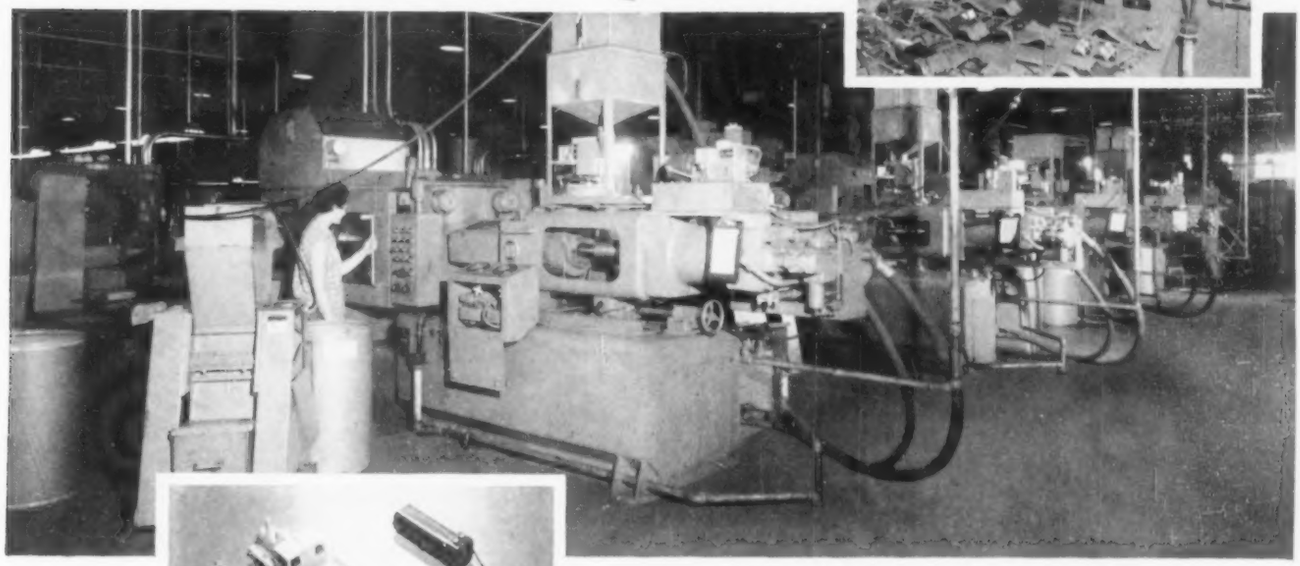
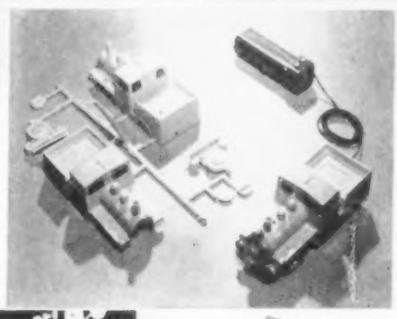


Fire Truck

Molding toy sports car on H-P-M 12 oz. machine.

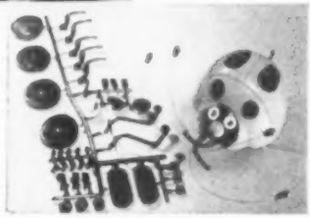


Battery of H-P-M 12 oz. machines at General Molds and Plastics Corp., Leetsdale, Pa.



Dinkie Train

Electric Toy Gun



Brainy Bug

At General Molds and Plastics Corporation, Leetsdale, Pa. a battery of H-P-M 12 oz. injection machines, using family type molds, turn out the extensive line of Andy Gard remote control electric toys. What makes the H-P-M "12" ideal for this type molding is that it's fast . . . has extra large platens for family type molds . . . plenty of daylight and stroke . . . and straight line hydraulic mold clamp for quick and easy set-up. "We've gone 100% H-P-M in our new plant," says Jim Giardina, Manager, "because H-P-Ms have everything a molder could ask for." There's plenty of reasons why so many plants go H-P-M "all the way". Send for the complete story of the H-P-M line, today.

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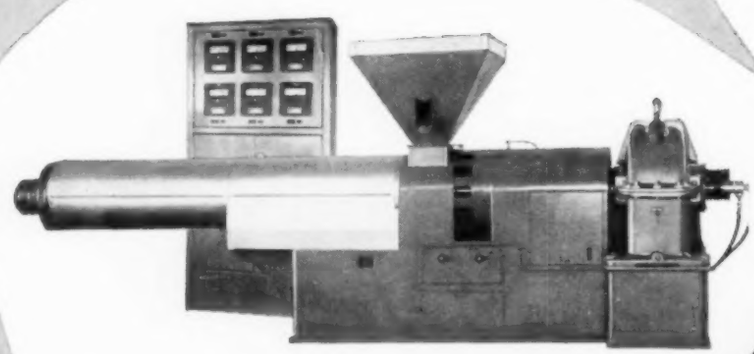

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even for the big ones it's

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. . . from warehouse stock

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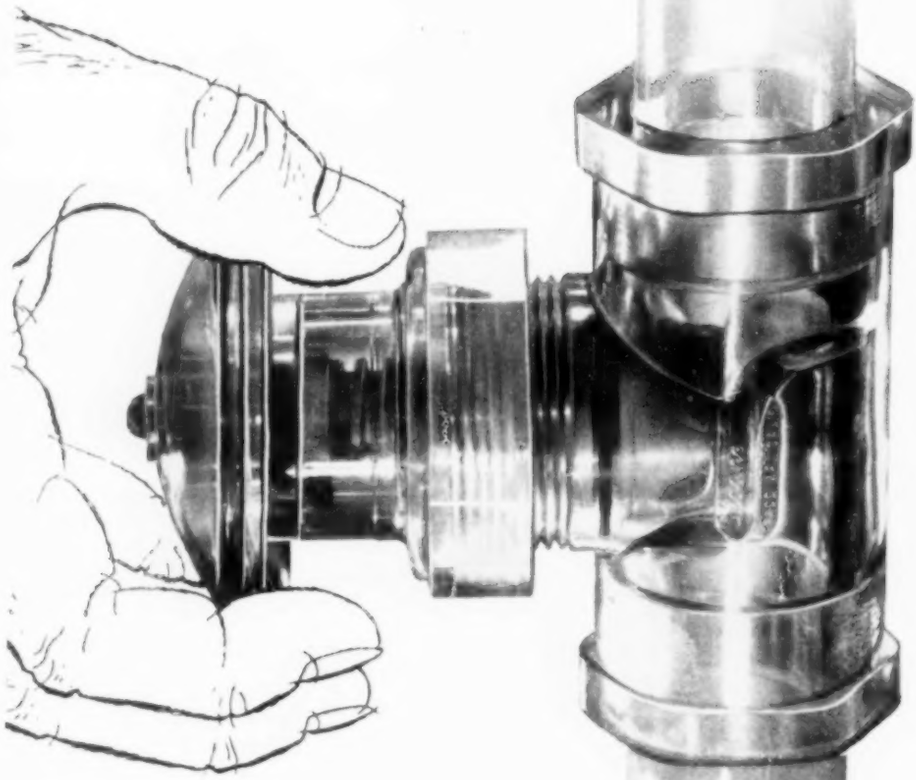


Sloane Manufacturing Co. has found several clear-cut advantages in producing new low-pressure valves of versatile Tenite Butyrate. This tough plastic is free from attack by rust and resists the corrosive action of many chemicals. Therefore, the plastic valve seat never becomes roughened from corrosion—the cause for so many leaky metal valves. Open, the Butyrate valves permit a smooth flow unimpeded by rust build-up. Closed, they give a positive seal. There are no washers to replace. What's more, since the valves are transparent, flow can be readily observed.

Speedy connections to Butyrate plastic pipe can be made by simply brushing matching surfaces of valve and pipe-end with solvent cement before joining. The valves are also available with threaded ends for use with conventional metal pipe carrying cold or mildly warm liquids.

Users find that Tenite Butyrate has high impact strength and stands up well under a wide range of weathering conditions. That's why this Eastman plastic has been used through the years for so many products that demand rugged strength, better performance, and longer life. An illustrated booklet describing Tenite properties and uses is yours for the asking. Write for a copy today to EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

● Information regarding Tenite also can be obtained from local representatives listed under "Plastics—Tenite" in the classified telephone directories of the following cities: Atlanta, Chicago, Cleveland, Dayton, Detroit, Houston, Kansas City, Leominster (Mass.), Los Angeles, New York City, Portland (Ore.), Rochester (N.Y.), St. Louis, San Francisco, Seattle and Toronto—elsewhere throughout the world, from Eastman Kodak Company affiliates and distributors.

Valve molded of Tenite Butyrate by Sloane Manufacturing Co., 12270 Montague St., Pacoima, California.

TENITE
BUTYRATE
an Eastman plastic

Continuous Winding Machinery For Plastic Film and Sheeting

J. E. Nordgren

Dilts Machine Works Division, The Black-Clawson Company, Inc.

ABOUT $400,000,000 worth of plastic film is manufactured yearly. In most instances the web producing equipment for these plastic products demands continuous operation in order to maintain uniformity. Heat balance and other stability problems exist in calendering, extrusion, and film casting machines which make it impractical to stop the process for changing rolls at the winder. Therefore it is important that sound continuous winding machinery be applied to these processes.

The purpose of this article is to bring forth the elements to be considered when making a selection of continuous winding equipment.

Winding Methods

Either of two basic principles is used in all winding machines: surface winding or center winding. Both principles are successfully applied to continuous winding machinery. By the surface winding method the winding roll is supported on a drum which is driven. The web travels under an idler roll, over the drum and to the nip formed by the winding roll and the drum.

In center winding the driving power is transmitted to the core or center of the winding roll and exerts a torque on this core to pull the material out of a processing machine and wind it into a roll.

Surface Winding Method

In the surface winding method the winding roll is supported on the driven drum and forms a nip against the drum; it is here that the driving effort of the drum is transmitted to pull the material from the process. The control of the friction at this nip, and the ratio of the drum speed to the speed of the basic process machine determine the tension in the winding roll. A small roll in the secondary arm position (see Figure 1) would have only light nip pressure against the drum, and a larger and heavier roll would have a correspondingly heavier nip pressure. Means of compensating for roll-weight effect can be accomplished by the addition of air cylinders or the like, adding to or relieving the roll weight. Assuming that there is no slippage at the nip, the amount of stretch produced by the difference between the speed of the drum and that of the basic process machine then creates the tension in the web. A continuous surface winder must also provide a means for transferring the web to a new core without stopping. Figure 1 shows that the primary arm holds a new core away from contact with the drum and in a ready position. This is schematically shown with the primary arms eccentrically mounted. Thus, when the arms are moved to a vertical position, the core contacts the surface of the drum. This action brings the core up to speed. The web can be severed ahead of the core on a diagonal and the leading edge of the diagonal turned over the core for the start. Another method is to sever the web between the core and the winding roll, again turning the leading edge over the fresh core. After the completed roll is removed, the new roll is transferred to the secondary arms to continue its winding to a full roll.

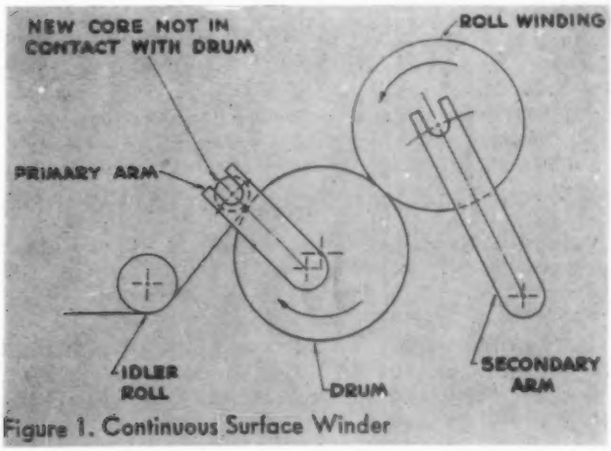


Figure 1. Continuous Surface Winder

Advantages of Surface Winding Method

To the company management interested primarily in initial cost, the surface winder is most attractive. The very nature of the machine design, being simple, usually makes this equipment less expensive than center-winding equipment. For a given diameter of winding roll, the surface winder is also more compact than the other. This requires less floor space for its installation. Simpler equipment also requires less maintenance, and these machines can usually be serviced by mechanics of ordinary skill. The simpler mechanical and electrical drive connections to power the surface winder also result in initial savings.

The production men find attractive the ability of the surface winder to handle a wider range of buildup ratios

This paper was presented at the 13th SPE Technical Conference.

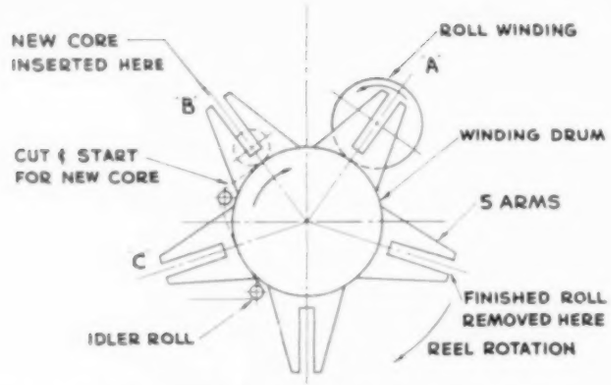


Figure 2. Continuous Surface Winder

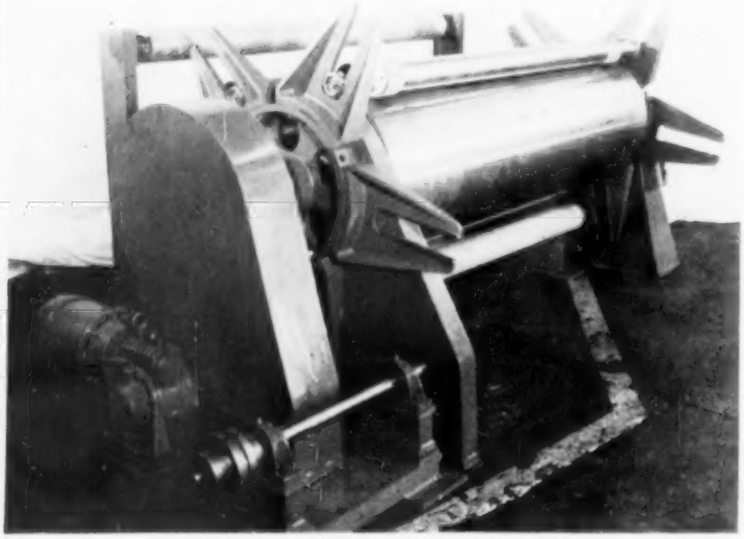


Figure 3. Continuous Surface Winder

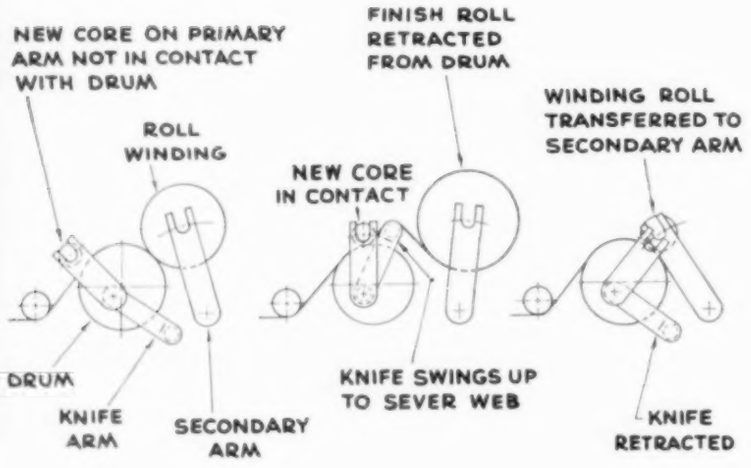


Figure 4. Surfastart Continuous Surface Winder

from core to full roll size, and its ability to produce denser and tighter rolls than are produced with center winding.

Because the winding roll or core is supported on the drum, the surface winder permits use of smaller cores or shafts and the handling of narrow web widths without concern for shaft deflection.

To the average operator, the simple adjustment for controlling tension with the surface winder is easy to understand. As surface winder drives are not dependent on the roll buildup ratio, synchronization of the winder with the process line equipment is somewhat simpler to tie in either mechanically or electrically than equivalent drives on center winders.

Disadvantages of Surface Winding Equipment

As was mentioned before, tension is controlled by regulation of the speed of the drum to the speed of the web, and by the weight of the roll or force applied to the roll against the drum. Since this is a friction drive at the nip, tension in the web and finished roll density are affected by the surface characteristics of the web and the loading at the nip. Because of these factors, the surface winder is limited in overall tension range and is not able to cope with extremely low tension ranges. In addition, extra equipment is required to measure or give the operator an indication of web tension.

Some plastic webs with coatings or otherwise sensitive surfaces are not suitable for surface winding due to marking or embossing effects. On a surface winder a roll with caliper variation principally on one side tends to wind into a conical shape and the roll may tend to telescope and be difficult to wind as desired.

Shafts or core mandrels are usually required on surface winders, and the additional handling required may be time consuming and require extra man-power at the winding operation.

With a surface winder, the new core can be accelerated against the drum on a comparatively slow-speed operation (up to 200 feet per minute) without detriment to the web, but at higher speeds the web tail of the completed roll may show marks where the core was accelerated, and starts on the fresh core are apt to be wrinkled or doubled over. In general, more waste can be expected on the surface winder than on the center winder. Also, adhesives are often applied to the core to assist in making the roll change. The surface winder is usually applied as a process winder and not as a finish shipping-roll winder. The problems associated with the slitting of multiple web widths, as required on a shipping roll winder, make the surface winder impractical in that application. The problems are inter-leaving, starting multiple webs simultaneously at roll change, and web caliper variations causing slit-roll diameter variance. Thus what may look like an initial saving in the purchase of a surface winder may end up as partial payment toward a finish shipping-roll winder which would require another operation.

In the following examples of continuous winding equipment, we shall discuss how various design improvements or attachments are incorporated in surface winders to improve operation or suit the machine to a particular requirement.

"Ferristart" Surface Winder

The "Ferristart" surface winder utilizes a five-man ferris-wheel construction which can rotate about the winding drum (Figures 2 and 3). This eliminates the need to transfer from a primary arm to a secondary arm and main-

tains the feature of adjusting the contact angle of the roll against the drum during winding. The rotation of the arms is motorized.

As a roll is winding, a new core is inserted in the next arm. At the time of roll change the operator makes a cut manually across the drum and the diagonal edge is flipped over the new core for a roll start. As soon as winding begins on the new core, the reel is indexed so that the axis of the slide on which the finish roll rides is below horizontal. The finished roll can then roll out onto a wrapping table.

Since there is no transfer of the roll from one arm to another from start to finish, this eliminates the possibility of tension changes or slight difference in web alignment that sometimes occurs in reels that transfer from a primary to a secondary arm.

This surface winder has found application to vinyl film and sheeting operations where the gauge of material is quite consistent. Several units have been installed in plants where the diameter of the wound rolls does not exceed 18" and the speed of operation is 25 to 100 yards per minute. This machine has been built to handle web widths from 48" to 92" wide.

"Surfastart" Continuous Winder

This surface winder consists of a driven drum with primary and secondary winding arm assemblies (Figure 4). Handwheel and gearing are provided for positioning the primary arm assembly. The secondary arm assembly is actuated by a double-acting air cylinder with valves and controls to vary loading force when the roll is against the drum. A third arm is provided with an idler roll and supporting cut-off knife. This arm is pivoted about the drum center and air-operated with controls synchronized, so that the idler roll and cut-off knife assembly cannot engage the web until the secondary arm is retracted. A "helper" center wind drive on the secondary arm with clutching mechanism at the outboard end is used to provide tension in the web at time of roll change, when the roll in the secondary arm is retracted from contact with the drum. The Surfastart winder with automatic cut-off is shown on the cover.

When a roll is winding in the secondary arm position, a new core is placed in the primary arms not in contact with the drum. The primary arm assembly is indexed toward the secondary arms to bring the new core in contact with the web on the drum, and the core comes up to web speed. The secondary arms are retracted with the "helper" center drive maintaining tension between the new core and the winding roll. The idler roll and knife arm assembly is brought into web contact in a position close to the new core. The action of the knife tripping severs the web and throws it around the incoming core which may have adhesive to pick up the cut end and wrap the new core. The completed roll is then stopped and unloaded from the secondary arms, and the idler roll and knife arm assembly is retracted. The secondary arms are lowered to a common position with the primary arms, so that the new roll is transferred to the secondary arms where winding continues. The primary arms are then returned to the starting position, and the cycle is repeated. The secondary arms containing the clutch to transmit the center driving effort to the winding mandrel can be engaged to maintain "helper" drive effort at the center of the roll.

The roll change can be made automatic, not requiring dexterity on the part of the operator. The center effort drive assists in making the rolls more firm at the center.

This winder has been installed successfully in operations for converting of cellophane, such as at the end of a printing press. This unit would also be useful for thin rigid plastic films or oriented stable films.

Center Winding Method

In center winding, as shown in Figure 5, the drive source is connected to the core or center of the roll and exerts a torque on this core. This means that a roll can be wound without surface contact with a drum or driven rider-roll. The manner in which the torque is controlled during the buildup of a roll determines the success of the winding.

For a more graphic illustration of the tension systems to be described, refer to Figure 6, which shows typical tension curves.

For constant tension on the material during roll buildup, the torque must be varied in proportion to the increase in roll diameter. With constant tension, the same amount of pull is applied to the web as a tangent force from core up to full roll. The result is increasing torque with increasing roll diameter.

Another type of center wind tension control provides constant torque. This means that as the roll builds up, the amount of pull in the web decreases in proportion to the roll buildup. There are instances in the handling of plastic web materials where a constant torque system

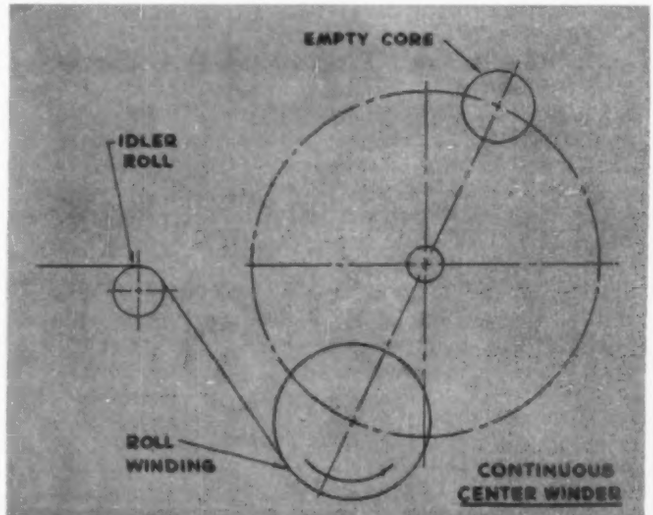


Figure 5. Continuous Center Winder

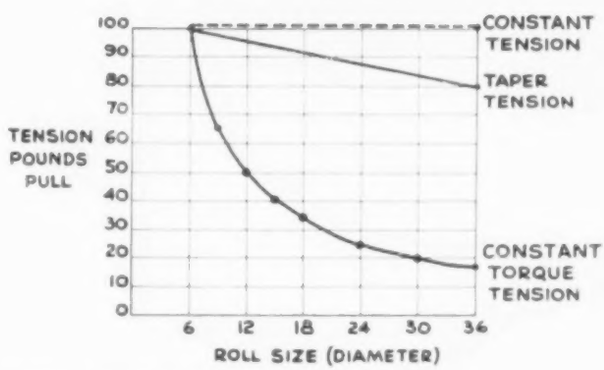


Figure 6. Tension Curves

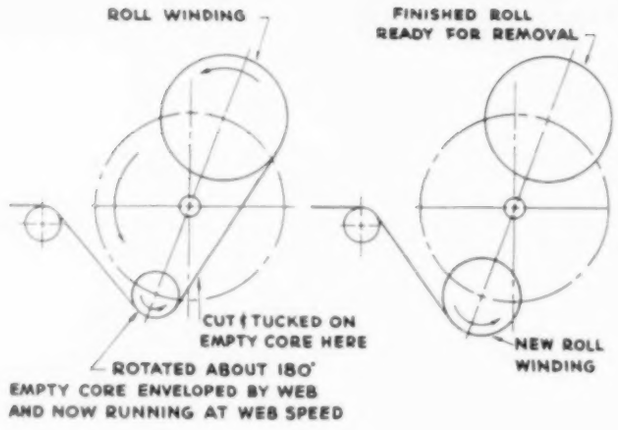


Figure 7. Model 20 Winder Operation

satisfactorily produces the desired wound roll. In these instances, the ratio of buildup from core to full roll is usually limited. A typical example would be starting with a 6" core and finishing with an 18" full roll. In this instance, web tension starting at 100 pounds would finish at 33 pounds tension.

Still another type of center wind tension control, that utilizes some of the factors of constant tension and constant torque, is taper tension. With taper tension the amount of pull in the web is decreased steadily at a uniform rate as the roll builds up in diameter. An example might start at the core with 100 pounds tension in the web and end at full roll size with 80 pounds tension, regardless of the ratio of buildup from core to full-roll size.

The constant tension system is generally the result of a constant horse-power regulated drive system, as found in hydraulic or electric winder motors, or in the use of a dancer roll to speed-control the winding roll during buildup. Taper tension is accomplished by changing the constant tension regulation system in accordance with roll size buildup. The constant torque tension curve is the result of slip-clutches or slip-belt type drives.

It is often desirable to decrease the tension during the buildup of the roll when winding plastic materials. This action has a tendency to overcome or compensate for material shrinkage or distortion encountered after the roll is completed or has been stored. Since the shrinkage is more pronounced in the linear direction, and the circumference at the core is less, the shrinkage is more apparent at the finish size of the roll.

Advantages of Center Winding Methods

Generally speaking, better starts are obtained at higher speeds and with less waste and wrinkling on the automatic type center winder than on a comparable surface winder. The reason starts are tighter and can be made at higher speeds on center winders is that these winders are more readily adaptable to automatic devices that permit cutting the web straight across and starting it on a new core.

Even in considering manual roll changes on the center winder, the operator can get by with less dexterity in cutting and wrapping the new core during a roll change.

There is less hazard without the nip that is used on the surface winder.

Greater flexibility is generally realized with the center winding methods. Tension in the web is readily varied through control of the drive source. Center winders more readily cope with caliper variations in the web by producing rolls of softer density through the ability to decrease the tension.

The new core can be brought up to web speed ready to receive the material after the cut, and the transfer made with minimum changes affecting the winding on the running roll. A properly designed center winder can be applied to the winding of shipping rolls directly from the process line. In this instance, the cores would be shafted to take care of center slitting. In other instances, when the center winder is applied as a process winder, larger cores may be an advantage and the unit can be used for shaftless operations.

The center winder lends itself to a building block design where the basic rotating roll stand becomes the foundation to which devices and attachments can be added for progressive stages of automatic operation. The machine can be designed to handle a range of web materials such as rigid or flexible, sheeting or film, and webs with sensitive surface conditions such as high slips or sticky webs which would tend to block.

Disadvantages of Center Winding

The line speed range of the process equipment greatly affects the selection of a center winder. The combined ratio of the line speed range and the roll buildup ratio from core to full-roll size are normally limited to 48:1 in order to keep within a controllable range of center winder drive systems. Both center winders and surface winders can be properly synchronized with the process line equipment, but it is somewhat more difficult to synchronize the center wind drives. To illustrate what is meant by the combined ratio of speed range, if the process line speed range is 25 feet per minute to 200 feet per minute, a ratio of 8:1 and the roll buildup ratio could be 6:1 starting with a 3" core and ending with a 18" diameter full roll. Thus, the combined ratio would be 8 times 6, or 48:1.

More floor space is required for the continuous center winder because a rotatable roll stand is generally a part of the equipment.

Deflection of the core mandrel when narrow webs are run on center winders, has to be guarded against to avoid roll bounce.

The following examples of continuous center winding equipment illustrate a modest means for accomplishing continuous roll changes with both manual operation and fully automatic operation.

Two-Arm Rotating-Reel Center Winder

In its simplest form, this winder (Figures 7 and 8) is a two-arm rotatable reel or turret. The arms that hold the rolls are mounted on a main shaft which is supported in bearings on side frame pedestals. A rotation drive mechanism is provided, for either manual or motorized operation, to rotate the main shaft. These units can be arranged to handle cores, shaftless or shafted, on roll mandrels at the spindle position. The spindle noses rotate in ball bearings and on the drive side are connected by clutches to the winding power source. On the opposite side of the machine a handscrew lockup is provided for chucking the shafts or cores into place.

In operation a roll is winding in one arm position and the winding power source is transmitted through the clutch mechanism to the shaft or core of the roll being wound. The second arm position has its clutch disengaged, so that a new shaft or core can be inserted into the spindle of the second arm position. The reel is ro-

tated, so that the fresh core is in near contact with the web. The new core is brought up to speed by engaging the incoming core clutch, or, by using an external driving source.

At the position ready for transfer to the new core, the new core is wrapped by the web. The operator manually severs the web, so that it can be wrapped and started on the new core. Almost simultaneously the winding power source is shifted from the completed full roll and engaged to the clutch of the new core. The finished roll is removed while the new roll is winding, and the process continues as before. This type of winder can be used with constant horsepower motors, slip clutches, and other types of winder drives. The selection of the proper drive is dependent upon the process and web material to be handled. Manual roll changes, as described above, are possible at speeds from 25 to 250 feet per minute.

An application for the two-arm rotating center winder is as a process line winder handling polyethylene or vinyl sheet and film. It is also used where the product would likely be rewound into shipping rolls. This type of machine is moderate in cost and offers maximum flexibility.

Automatic Plastic Center Winder

The automatic plastic center winder (Figure 9) is a two-spindle rotatable winder designed for continuous operation under pushbutton control.

The rolls are wound on mandrels over which paper cores are slipped and locked. The mandrels are chucked manually into the reel spindles by a quick-acting lockup. The winding power is supplied to each roll arm by separate D.C. motors mounted on each arm and directly connected to each driving spindle through gearing. A specially constructed low-inertia dancer roll is provided ahead of the winder for controlling the winder motor speed.

The roll-change mechanism for automatically severing the web and wrapping the new core consists of an air-actuated serrated knife, a backup idler roll on one side of the core, and a pressure roll on the opposite side of the core, for enveloping the web about the core at time of roll change. The knife has a series of flat brushes located in back of the cutting edge to sweep the film onto the core after it has been cut.

In operation a roll is winding in one spindle position with the dancer roller controlling the winder motor speed for a given tension. When the winding roll is small, the dancer roll is in a low position, and, as the winding roll increases in diameter, the dancer roll rises. A signal from the dancer roll position is used to control the speed of the winding motor. When the winding roll nears completion, either an automatic signal from a yardage counter, or a signal from the operator, starts the turret rotating for a roll change. The new core is driven at a speed that is referenced to the process line or web speed. When the indexing of the new core has progressed to the roll change position, the backup and brush rollers envelope the new core and the serrated knife and flat brushes sweep across the core to make the start, normally without foldback or wrinkling.

As soon as the new core is winding, the motor powering the new core slows down slightly to allow the dancer roll to lower to its normal position where auxiliary controls transfer the new winding motor back to the dancer roll control.

The completed roll stops when the knife severs and wraps the new core, so that the full roll can be removed and a new core inserted for a continuance of the cycle.

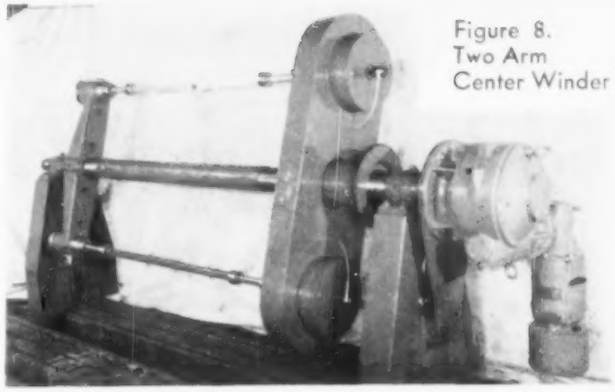


Figure 8. Two Arm Center Winder

This winder has found its primary application on plastic calender installations where round-the-clock operation in very high-quality wound rolls is required. The winder does not require adhesives on the core, makes starts without fold-back or wrinkling, and winds under very accurate tension control. Speeds up to 500 feet per minute can be realized with this machine. Units installed handle webs from 60" to 108" wide, slitting finished shipping rolls on 3" or 6" cores and up to 30" diameter maximum roll size.

Conclusion

The producer of plastic film and sheeting has to invest large sums of money in the basic processing equipment and too often considers the winder as a necessary evil. It is unwise to consider the winder on a price basis alone. To limit the productivity of an expensive process line by the installation of an unsatisfactory winder is not a sound policy, particularly when the cost of the best automatic winder is only a small fraction of the total investment. After all, the success of the processing equipment is determined at the winder.

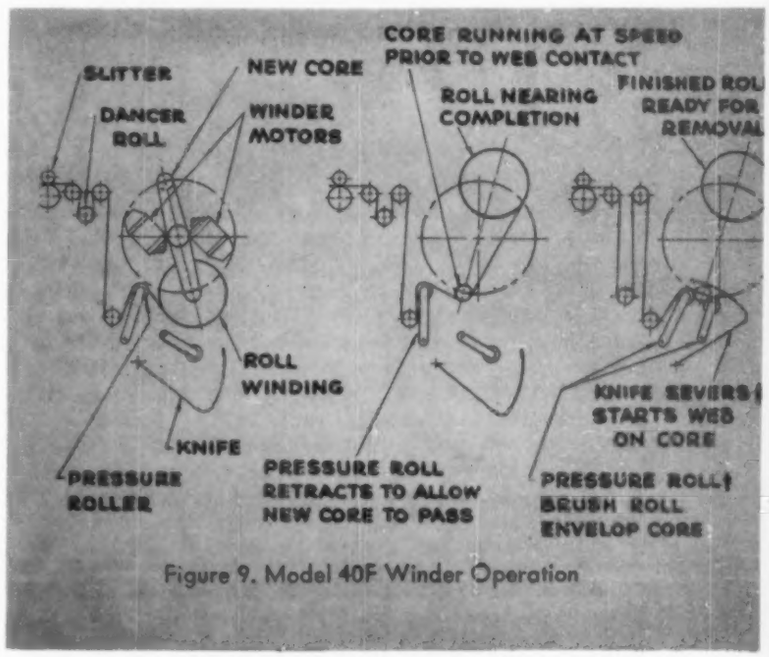


Figure 9. Model 40F Winder Operation

The Effect of Gating on . . .

Molding Linear Polyethylene

F. J. Rielly, V. Hill and D. A. Jones
Celanese Corporation of America

. . . gate size and design have a profound effect on direction of shrinkage and on impact strength of molded polyethylene . . .

THIS PAPER is to be considered a progress report on the study of molding linear-type polyethylene. A hypothesis is also advanced relating shrinkage and part warpage to gating and the resultant arrangement of flow.

Fortiflex* A is a general purpose linear-type polyethylene resin of high density, stiffness and toughness made by the Phillips process.

Some of the properties of linear polyethylene are relatively insensitive to molding conditions while others are to a large extent under the control of the molder. In a recent paper (1), it was shown that the impact strength and mold shrinkage values can be altered by adjusting the injection molding variables of time cycle, cylinder temperature and mold temperature. On continuing this approach of examining variables under the control of the molder, the effect of gate size was explored and it was found that the impact strength (Izod) and the mold shrinkage were also dependent on the size of the gate. It was also noted that the location of the gate had a marked effect on the warpage of the piece.

Molding Conditions and Gate Sizes

To determine the effect of gate size on the Izod impact strength and mold shrinkage, specimens of the standard ASTM tensile bar of 0.125 inch thickness and a 3 inches x 5 inches x 0.125 inch plaque were injection molded in dies having the runner system terminate at gates located in replaceable inserts. Gates of various sizes of an oblong shape with a base three times the depth and a constant land length of 0.050 inch were cut into the inserts. Five gates of this design were used ranging in size from 0.010 inch by 0.030 inch to 0.075 inch by 0.225 inch. Our standard tensile bar gate 0.125 inch by 0.250 inch half-round was also included in the series. The molding conditions, gate sizes and cross sectional area of the gates are listed in Table I.

*Fortiflex is a Celanese trade name.

This paper was presented at the 13th SPE Technical Conference.

Effect of Gating on Izod Impact Strength

The Izod impact strength was determined at 73°F on notched specimens according to the procedure given in ASTM D256-54T. All specimens gave a hinge-type break under the conditions of the test. The values obtained on specimens varied from 12.6 to 14.3 foot pounds per inch of notch and in general showed an increase with increasing gate size. Typical test results for notched specimens prepared with various gate areas are shown in Figure 1.

Effect of Gating on Mold Shrinkage

Specimens prepared under constant molding conditions with various gate areas were measured for mold shrinkage about one week after molding.

Figure 2 shows a 3 inches by 5 inches by 0.125 inch plaque which has been side-gated. The shape of the cavity is shown as a solid line and the shape of molded piece superimposed as a dotted line. It was noted that the pieces were slightly distorted, and when superimposed on the cavity, the short side at the gate end extended over the upper edge of the cavity.

Measurements were made to determine the reduction

Table I

Molding Conditions

SPECIMEN	TENSILE BAR	PLAQUE
TIME CYCLE	30 SECS (16-10-4)	45 SECS (25-15-5)
MOLD TEMP.	150°F.	150°F.
CYLINDER TEMP.	410°F.	400°F.
INJECTION PRESSURE ON MATERIAL	11,000 P.S.I.	10,000 P.S.I.

Size of Gates Inches	Cross Sectional Area Sq. In.	Ratio of Areas
0.010 x 0.030	0.0003	1
0.020 x 0.060	0.0012	4
0.030 x 0.090	0.0027	9
0.055 x 0.150	0.0082	27
0.075 x 0.225	0.0169	55
0.125 x 0.250 (Half Round)	0.0245	81

Effects of Gate Area

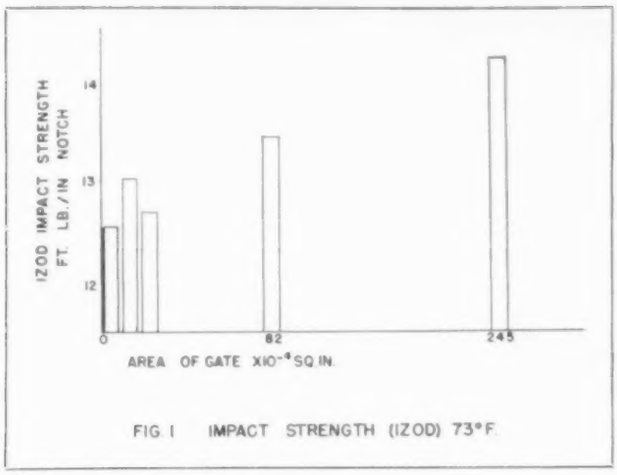


FIG. 1 IMPACT STRENGTH (IZOD) 73°F.

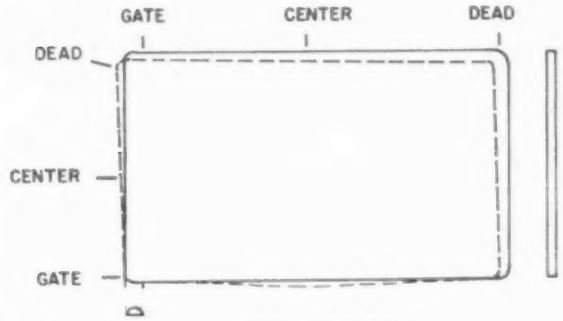


FIG. 2 PLAQUE

in the overall length and width at the gate end, the center and the dead end. The increase in mold shrinkage with a very small gate area (0.0003 sq. in.) is illustrated in Table II. The mold shrinkage is relatively constant with gates from 0.0012 to 0.0245 sq. in.

Effect of Flow Direction on Shrinkage

In the preceding section the effect of a small gate size on mold shrinkage has been demonstrated. Direction of flow also determines the amount of shrinkage. The shrinkage at right angles to the direction of flow is always less than the shrinkage parallel to the direction of flow.

Figure 3 obtained by injecting a mixture of two colors, shows the flow pattern of the plaque mold with the particular gating used.

Table II

Mold Shrinkage

AREA OF GATES SQ. INS.	MOLD SHRINKAGE PERCENT Length Gate	Center	Dead	Width Gate	Center	Dead
0.0003	3.7	3.1	3.0	3.1	1.9	2.8
0.0012	3.0	2.6	2.5	2.8	1.7	2.6
0.0027	2.9	2.6	2.6	2.7	1.8	2.6
0.0076	2.9	2.6	2.5	2.7	1.8	2.7
0.0174	2.8	2.5	2.6	2.6	1.8	2.6
0.0245	2.9	2.6	2.5	2.6	1.5	2.6

Direction of Shrinkage Depends on Plastic Orientation

FIG. 3

ANALYSIS OF ORIENTATION AND SHRINKAGE – TEST PLAQUE

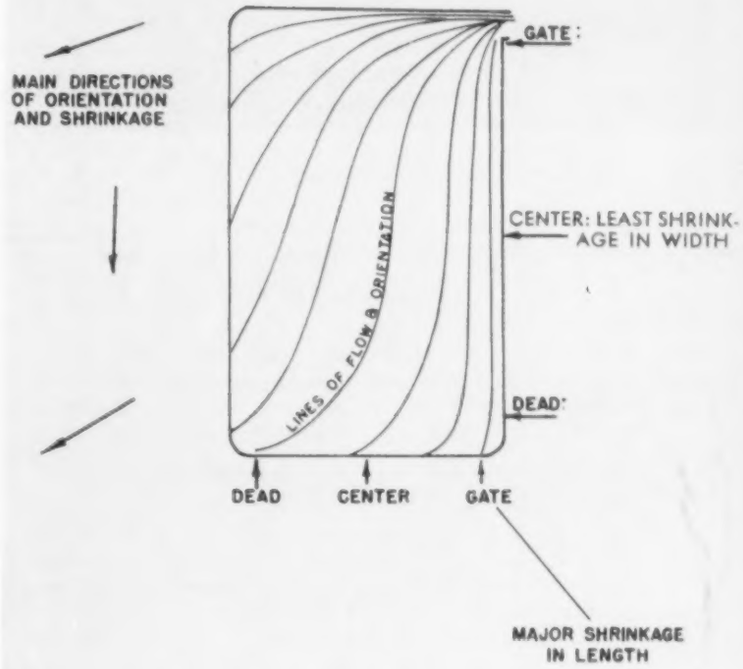
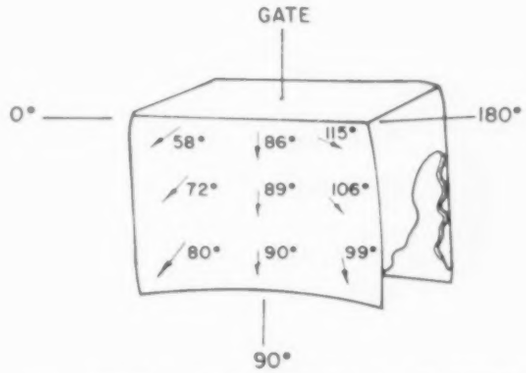


FIG. 4

ORIENTATION IN SIDE WALL OF MOLDED HOLLOW BOX



(∠°) SHOWS DIRECTION AND ANGLE OF ORIENTATION AS DETERMINED BY X-RAY DIFFRACTION PATTERN

Figure 5

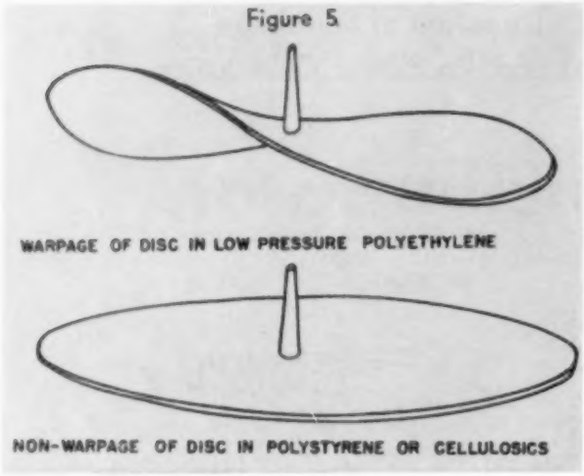


Figure 5 (Top) shows the warpage of a low-pressure polyethylene disc.

Figures 6 (Below) and 7 (Top right) illustrate that shrinkage follows the lines of plastic flow.

Figure 8 (Below right) illustrates how a multiple-gated mold can reduce warpage by providing a balanced set of localized stresses.

Figure 7

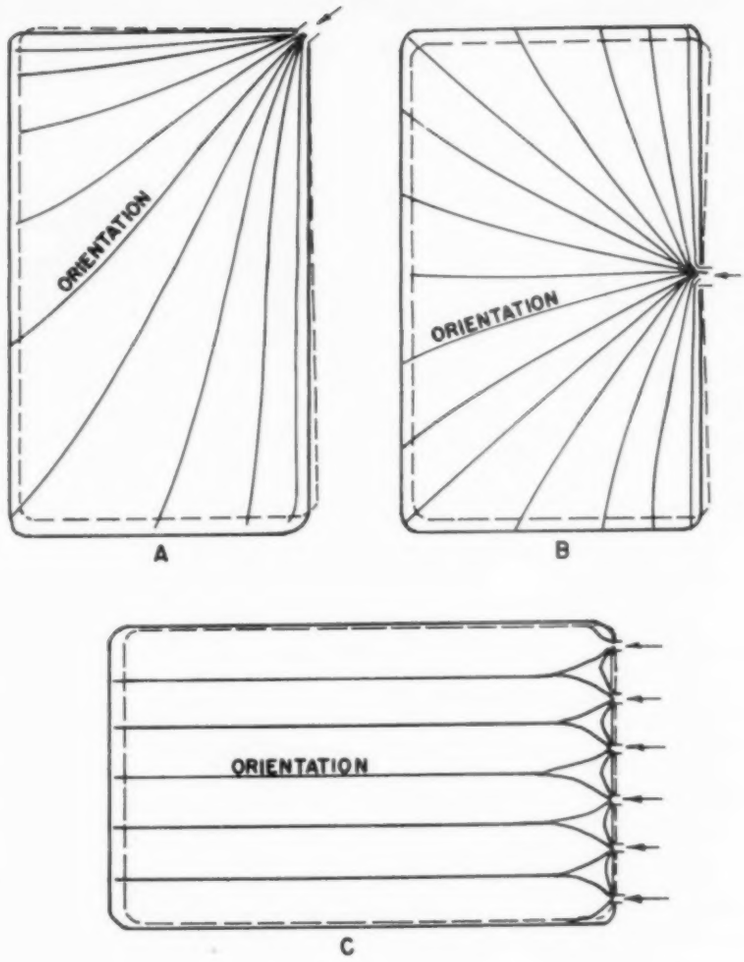
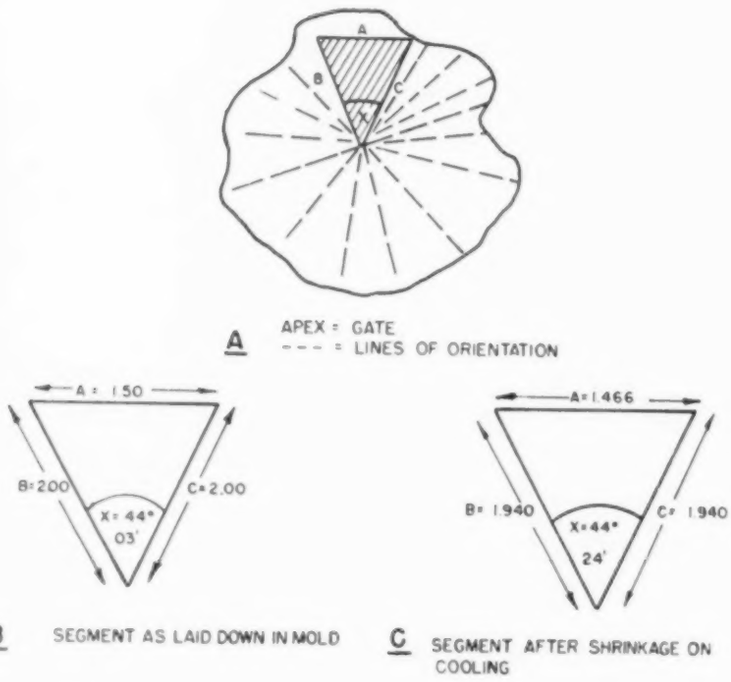


Figure 6

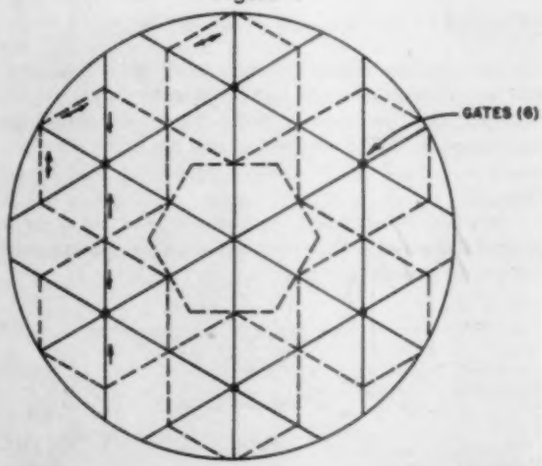


A APEX = GATE
--- = LINES OF ORIENTATION

B SEGMENT AS LAID DOWN IN MOLD

C SEGMENT AFTER SHRINKAGE ON COOLING

Figure 8



BROKEN LINES SHOW EXPANSION FORCE OF ANGULAR CHANGE

SOLID LINES SHOW TENSION FORCE IN DIRECTION OF ORIENTATION-BALANCING STRESS.

NOTE. ADEQUATE VENTING WILL BE REQUIRED FOR THE RELEASE ENTRAPPED AIR

Under one set of molding conditions and with the above flow pattern, the shrinkage was found to be in the region of 3 percent in the long dimension where the direction of flow was approximately parallel and about 1.8 percent across the center of the piece approximately at right angles to the long dimension. Changes of molding conditions and particularly in part shape can vary both of these amounts of shrinkage but cannot obviate the differential factor.

X-ray diffraction patterns of molded pieces indicate definite crystallite orientation in the direction parallel to the flow. In the case of a flat disc, sprue-gated directly in the center, this orientation exists radially and outwardly toward the periphery. In the side wall of a hollow rectangular box, the orientation is as shown in Figure 4.

Warpage

The values given in the foregoing section relate solely to differential shrinkage in end-gated pieces. When radial flow from a center-sprued piece is introduced, warpage becomes a problem, as illustrated in Figure 5. The same phenomenon manifests itself in partial shots of the bottom of large area parts such as dish pans and even in bottoms cut from full shot pieces.

Parts obtained this way from convention (branched) polyethylene show the same characteristic warpage, while parts in polystyrene, cellulosics and other non-crystalline structures remain flat and free of warpage.

It is believed that this type of warpage is due to an angular change in the segmentary volume, in the plane of the segment, after the mold is filled and during the cooling cycle.

If, as shown in Figure 6 A and B, an imaginary segment arbitarily set at **side B** = 2.00 inches, **side C** = 2.00 inches and **base A** = 1.50 inches be taken of any radial flow section, at the moment the mold has filled and the flow ceased, **angle X** can be calculated from the formula $\text{Cos } X = (B^2 + C^2 - A^2)/2\,BC$ to be 44° 3'.

If, for purposes of illustration, we pick 3.0% and 2.25% as the radial and circumferential shrinkages, respectively, the effect on warpage can be calculated. When the differential shrinkage upon cooling is applied to the segment at the rate of 0.0300 inch per inch to **sides B** and **C** and at the rate of 0.0225 inch per inch to **base A**, the respective measurements are **side B** = 1.940 inches, **side C** = 1.940 inches, **base A** = 1.466 inches, and **angle X** = 44° 24'.

It can now be seen that **angle X** was laid down at 44° 3' and after shrinking on cooling has become 44° 24', thus expanding radially 21'.

The effect is to change the angular volume in a direction at right angles to the orientation, at the rate of approximately one-half minute per degree of segment. This sets up severe compressive strains which manifest, upon release from the mold, in the form of a pronounced buckling, varied in degree by the amount of differential.

Reduction of Warpage by Piece Shape and Mold Design

Proper part and mold design make it possible to obviate or greatly reduce the tendency to warp. Where edge gating is indicated, the flow should proceed parallel to either the long or short axis of the piece, depending upon which dimension allows the straightest possible non-turbulent flow. The use of as many gates as practical on the edge to prevent or balance radial flow patterns, is indicated.

Drawings A and B of Figure 7, using single gates, illustrate part distortion on cooling of a simple rectangular plaque using two gate locations. Flow orientation is shown for each gate position. Drawing C shows how multi-gating from a common runner should enable shrinkage to take place without angular distortion.

Studies are under way to determine the optimum gating for specific part design.

"Dissection" of several round symmetrical sprue-gated parts such as containers or pans, which appeared free of distortion, revealed several interesting observations. The flat bottom sections, upon being cut from the side walls, immediately warped. Several parts were fabricated incorporating various degrees of lips or edge reinforcing. The use of a small lip, 0.035 inch in thickness by $\frac{5}{8}$ inch in height, appeared sufficient to hold a disc 6 inches in diameter by 0.035 inch in thickness in true plane. This shows the possibility of part design as a means of preventing warpage in round symmetrical parts. This study is being extended to explore both edge reinforcing and radial rib formations to overcome warpage in non-symmetrical moldings.

In the case of non-symmetrical moldings having objectionable warpage, where it is not possible to alter part design, it is believed that a multi-sprued mold should be used in place of a center-sprued mold. This is employed to yield warp-free moldings with conventional polyethylene. While this design technique does not alter radial flow, it should greatly reduce the stress force concentration at a given point by providing several localized stress areas in balanced pattern, as illustrated in Figure 8.

Multi-gating may be required for both symmetrical and non-symmetrical pieces depending on the configuration of the part. An example of such a symmetrical shape would be a hollow cylinder. This would probably have to be multi-gated at the end of the piece to arrange the flow orientation parallel to the long axis and prevent warpage out of round. Non-symmetrical shapes and articles with uneven wall thicknesses may also require multi-gating.

Summary

The size of the gate has an effect on the impact strength and values increase with increasing gate size. The size and position of the gate affect the shrinkage of molded linear polyethylene. Both the length and the width shrinkage increase with small, restricted gates.

Flat pieces can be molded with a minimum of warpage if the gate is placed at the edge in a position to approximate a pattern of parallel flow. Single gates may also be used on symmetrical shapes such as tumblers or bowls, which are gated into the center of the base and have sufficient rigidity in the wall sections to prevent warpage.

To minimize distortion and warpage, multiple gating may be required for certain symmetrical as well as non-symmetrical pieces. The gates should be located according to a geometrical pattern, so that the shrinkage is controlled and counter-balanced. Where multi-gating is sufficient to prevent warpage, a rim contour or reinforcement may be required around the edge of the piece to balance the stress.

Reference

1. F. J. Rielly and W. A. Hunter "The Effect of Molding Conditions on the Physical Properties of Fortiflex A". Paper presented at the National Meeting of the American Chemical Society at Atlantic City, New Jersey, September 19, 1956.

Polyethylene Fibers

A. T. Widiger, G. H. Youse and T. C. Broadwell
The Dow Chemical Co.

. . . linear polyethylene monofilament can be made on conventional melt-spinning equipment. Properly stabilized, it will find a host of applications . . .

WITH THE introduction of the organo-metallic catalyst system to the plastics industry in 1954, a new dimension in high polymer chemistry was founded. The utilization of these catalysts in the polymerization of olefins resulted in products heretofore unknown. The first of these was known as low pressure or linear polyethylene to contrast it with high pressure or branched polyethylene.

Linear polyethylene, compared to branched polyethylene, is a more crystalline polymer, having a higher heat distortion temperature, lower permeability, increased tensile strength, increased stiffness and improved chemical resistance.

Because of Dow's background in the melt spun fiber field with saran monofilament, it was only natural that the utility of linear polyethylene in this application was among the initial areas of investigation and development.

Equipment Corrosion

During early work with linear polymers, it was recognized that catalyst residues in the polymer had, during processing, a highly corrosive effect on the common steels used in fabrication equipment. It was felt that until this basic problem could be overcome, initial field development work could best be handled on saran fabrication equipment which is constructed of high nickel alloy metals. This equipment is resistant to these corrosive effects.

As polymer research work proceeded, highly effective stabilizers were developed which eliminated the corrosion problem with regular metals of construction and allowed evaluations to be undertaken in other fields on standard equipment. Through improved polymer processing techniques, it is hoped that the need for corrosion inhibitors will no longer be necessary.

Development Program

In order to establish and expedite a development program for linear polyethylene monofilament, it was decided that initial filament extrusion would be of 10 mil monofilament, similar to that used in present monofilament fabrics. This direction of study would serve the following purposes:

1. Current extrusion, orienting and spooling systems would be immediately available for development work, permitting rapid evaluation of the material processing characteristics.
2. The fabric produced could be processed in present monofilament looms and tested comparatively with similar fabric constructions of other materials.
3. It was felt that the relatively large size of 10 mils would lend itself to easier extrusion in the development studies. Basic processing conditions could then be investigated without possible added problems often encountered in producing very fine filaments.

Equipment Description

With the Dow background in saran filament extrusion, initial tests were made with standard saran equipment. This system is shown in Figure 1. The extruder is a steam heated 2½" diameter unit with a single flight screw having a constant pitch of 2½", a compression ratio of about 5:1, an overall length of 30" and a smooth torpedo section of 5".

The die channeling is streamlined as much as possible to minimize plastic holdup or stagnation with resultant thermal decomposition. The circular strand die contains 43 holes with a die hole diameter of 0.038". A water quench tank is used to cool the extruded filaments to the desired orientation temperature. After leaving the water tank, the cooled filament band is wrapped several times on a set of snub rolls which serve to control the take-away from the die. Several wraps are then taken about a set of orienting rolls which, traveling at a faster speed, stretch or orient the filaments. This orientation results in higher tensile strengths and greater flexibility than can be achieved in unoriented filament. The filaments are then separated and led to individual spools on a spooling unit.

Saran System

The operating conditions which result in optimum filament properties in saran monofilament are shown in Figure 2. Maximum extrusion temperatures of 170°C are required. Water bath temperatures should be between 10°C and 15° with about two feet of filament immersion. Orientation takes place at room temperature by running the orienting rolls at about four times the surface speed of the snub rolls.

Saran, which is normally highly crystalline in the solid state, has a sharp crystalline melting point and becomes completely amorphous above the melting temperature. When saran is rapidly cooled to a sufficiently low temperature, the resultant soft rubbery solid has the unique characteristic of remaining amorphous and is said to be in a supercooled state. Mechanical working of supercooled filament, as in an orientation process, results in the

recrystallization of the polymer with an accompanying high degree of orientation. Such treatment produces fibers of high strength and flexibility. This explains the low cooling bath temperature used in the saran system.

Branched Polyethylene System

High pressure or branched polyethylene monofilament can be successfully produced on this equipment by increasing extrusion temperatures and orientation ratios. The resultant conditions are shown in Figure 3. Although branched polyethylene is not supercooled in this process, cool water bath temperatures appear to be best suited for the operation. Extrusion temperatures up to 205°C are used and orientation ratios may vary from 4:1 to 10:1, depending on the type of polymer being extruded.

Linear Polyethylene System

The extrusion of linear polyethylene monofilament on the saran system requires a material temperature of about 210°C for optimum extrusion results. However, continuous filament breaks occur with the use of a cold water quench and room temperature orientation. Only when the quench tank temperature is increased and a means of maintaining filament temperature on the snub rolls utilized, is the problem of filament breaks overcome. The processing conditions resulting are shown in Figure 4. The hot plastic filaments are cooled to a temperature of about 100°C in the quench tank and maintained there during orientation by the heated snub rolls which are held at 110 to 115°C. Experience indicates that maintenance of the proper plastic temperature during orientation is very important. A tolerance of plus or minus 10°C in the heated rolls is all that can be permitted. Low temperatures cause filament breaks and high temperatures cause sticking of the filaments to the hot rolls.

In the orientation section, maximum possible stretch is desired. This is achieved by stretching a sample to the breaking point and then reducing the orientation ratio slightly. Orientation ratios vary between 5:1 and 10:1 for the available linear polyethylenes tested.

In this work, the screw, filter system and die design normally employed for saran extrusion was highly satisfactory. Equivalent volumetric output was obtained with the linear polymer for given screw speeds. The spooling equipment normally used for saran filament was found to be satisfactory for the linear polyethylene filament. With slight modifications, weaving of the filament into fabric was carried out on regular saran monofilament looms.

Monofilament Properties

In addition to basic studies on the processing of linear polyethylene for monofilament, properties of such a fiber also had to be evaluated in order to best judge the market potential. General property differences between linear polyethylene and the older high pressure or branched polyethylenes are well known. As mentioned previously, these include higher tensile strength, increased stiffness or rigidity, higher heat distortion temperature, improved chemical resistance and lower permeability. However, little public information has heretofore been presented on specific linear polyethylene monofilament properties. Figure 5 compares the properties of linear polyethylene monofilament with those of conventional branched polyethylene and saran.

1. Tensile strengths of linear polyethylenes vary considerably, due partly to variations in existing polymers at this relatively early stage of development. Recently produced linear polyethylenes have had considerably higher

Figure 1. Saran Monofilament Extrusion System

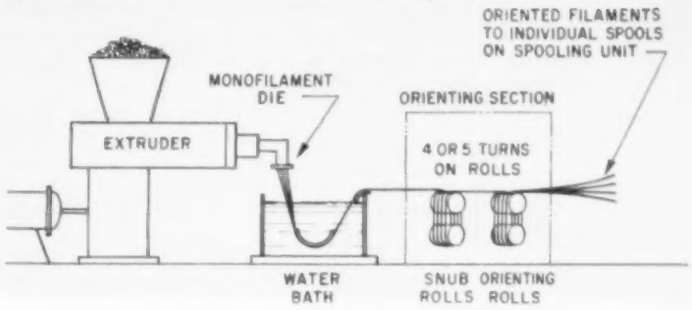


Figure 2. Saran Monofilament Extrusion Process

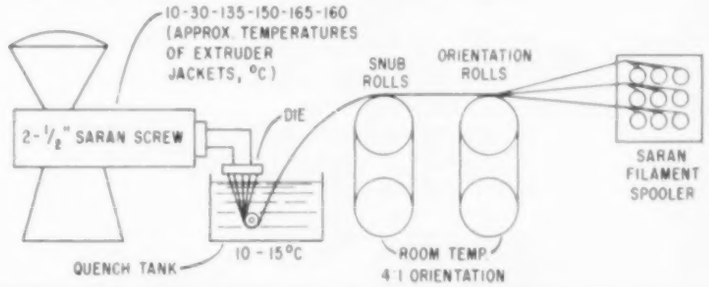


Figure 3. High Pressure Polyethylene Extrusion Process

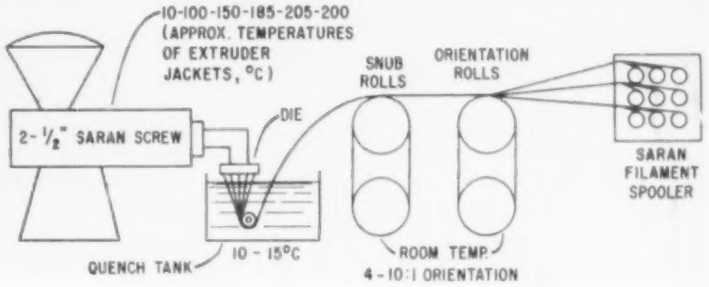


Figure 4. Linear Polyethylene Monofilament Extrusion Process

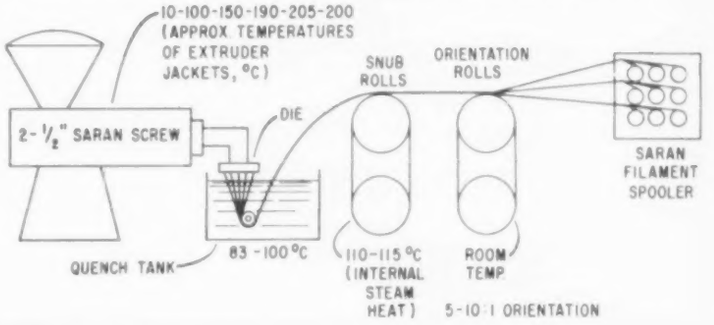


Figure 5. 10 Mil Monofilament Property Comparison

	DENSITY	TENSILE STRENGTH, PSI	ELONGATION, %	MODULUS, PSI	KNOT STRENGTH, PSI	IMMEDIATE SHRINK, %-100°C H_2O	BEND RECOVERY, %	FABRIC FLEX LIFE CYCLES
SARAN	1.67	30,000 to 50,000	20-25	1.2×10^5	20,000 to 30,000	8-15	89	30,000
BRANCHED POLYETHYLENE	.92	UP TO 40,000	20-25	0.6×10^5	10,000 to 18,000	50	56	–
LINEAR POLYETHYLENE	.95	60,000 to 90,000	18-20	3.5×10^5	40,000 to 60,000	5-10	56	55,000

tensile strengths than any branched polyethylene checked and higher than the range normally obtained with saran. Tensile strength is to some extent related to filament diameter. Linear filament smaller than 0.010" in diameter has shown strengths of well over 100,000 psi.

2. Elongations of all three materials appear to be about equal for well oriented specimens.

3. Tensile modulus data show the stiffness of linear polyethylene monofilament to be greater than that of branched polyethylene or saran. Therefore, in similar fabric constructions, the linear product is stiffer or boardier.

4. Linear polyethylene knot strength values are considerably higher than those of branched polyethylene and saran. In some monofilament applications, knot strength is thought to be of more importance than tensile strength, since filament failure generally takes place at some point of concentrated stress.

5. Values for immediate shrink in water at 100°C give an indication of how much shrinkage may be expected under normal filament or fabric processing steps. Linear polyethylene has about five to ten percent immediate shrink when fabricated by the extrusion system mentioned previously. Values obtained with saran fall in approximately the same range. The high shrink of branched polyethylene definitely limits its use as a normal fabric material.

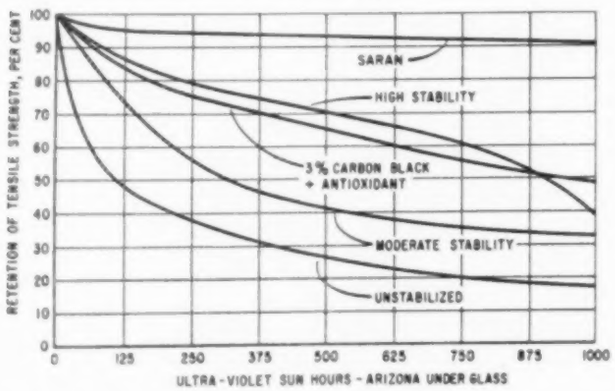
6. Bend recovery in terms of a fabric means crease or wrinkle resistance. A bend recovery test has been developed in which a single filament is bent around a 1/8" diameter rod. It is held in this position for a 15 second period and then released. The percent recovery back toward a straight filament is checked after one minute. This single filament test correlates with past experience on saran, branched and linear polyethylene fabrics showing that only the saran has good bend recovery. This characteristic may be a major disadvantage of linear polyethylene fabrics.

7. The original flex life of early samples of linear polyethylene fabric is somewhat greater than that of saran. Data on samples exposed to ultraviolet light show an extremely sharp drop in flex life with the linear material, whereas saran is only slightly affected. However, it is expected that polymer improvements and advancements in stabilization with linear polyethylene will ultimately bring about improvements in this characteristic.

Stabilization

Another very important aspect of the linear polyethylene property picture is that of stabilization. The main effect of exposure to weather on both linear and branched polyethylene is a reduction in tensile strength, elongation and flex life. Since the major factors affecting these properties are oxidation and ultraviolet radiation, consideration must be given to the addition of antioxidants and ultraviolet stabilizers to linear polymers intended for monofilament usage. The effect of heat is largely that of accelerating oxidative degradation and, therefore, a specific additive for heat stabilization is not necessary.

Figure 6. Stabilization of Linear Polyethylene



Exposure Tests

When making outdoor exposure tests with monofilament, samples are exposed to the sun either directly or under glass. The unit of exposure is the ultraviolet sun hour (UVSH), with approximately 2000 of these units being attained per year at the Arizona exposure location utilized.

Figure 6 shows stability curves for monofilament exposed under glass, expressed as percent retention of the original tensile strength, versus time of exposure. By expressing exposure data in this manner, for saran and unstabilized as well as stabilized versions of linear polyethylene filaments, the relative degrading effect of ultraviolet exposure becomes apparent.

1. Unstabilized linear polyethylene shows a very marked degree of degradation after a relatively short period of time. However, it should be recognized that if a particular sample has an exceptionally high tensile strength initially, it could still perform satisfactorily in many applications after losing a large percentage of its initial strength.

2. The addition of approximately 2-3% carbon black, and, in some cases, antioxidant, has long been a standard means of stabilizing branched polyethylene, though color is limited to black. It can be seen that the incorporation of this type of system with linear polyethylene has brought about a significant increase in stability.

3. Early attempts to achieve a satisfactory level of stabilization, without employing carbon black, resulted in materials having "moderate stability" and a color suitable for the preparation of a limited range of color formulations.

4. Additional stabilization work resulted in a material having relatively "high stability" and a color which made possible the preparation of bright and pastel shades.

Potential Markets

Field evaluations are currently being conducted with linear polyethylene fibers in such applications as automobile seat covers, industrial filter cloth, furniture upholstery, tarpaulins, rope and other similar filament uses. Extensive utilization of the material in these applications will depend upon the performance data gathered. However, initial results indicate that linear polyethylene will ultimately present a challenging position in the melt spun fiber field.

Conclusions

It has been shown that conventional monofilament fabrication equipment can be utilized in the extrusion of linear polyethylene polymers. The adaptation of this equipment requires only slight modification to achieve proper processing conditions.

The properties of this material appear to be satisfactory for many of the present melt spun fiber applications.

Stabilization of these polymers against the effects of oxidation and ultraviolet radiation is an important consideration. Definite progress has been made along these lines and work is continuing to further enhance the properties of linear polyethylene as a melt spun fiber.

Glass-Flake Laminates . . .

. . . low-cost, great stiffness are advantages of this unique glass-resin combination . . .

George Rugger
Picatinny Arsenal

THE ARMY ORDNANCE CORPS became interested in preparing glass reinforced laminate with the reinforcement in the form of flakes rather than fibers. This objective was undertaken through a group of contractors.

There were seven reasons which led to the interest in this type of construction. The first of these was that the flake should have multi-directional properties as contrasted to the uni- or bi-directional properties of the woven fiber laminates. If they did have, the effective strength to weight ratio could be improved. In the ordinary glass cloth laminate, one half of the glass fibers contribute to the weight whereas they contribute nothing to the strength when a uniaxial load is applied to the plane of the laminate. On the other hand, in a flake laminate, each particle of glass which contributes to the weight would also contribute to the strength. In addition, this contribution would be effective regardless of the direction of the applied stress in the plane of the laminate.

The second reason for investigating this type of construction was based on a knowledge that with fiber laminates, large voids have to be filled with resin and the cylindrical shape of the glass results in a minimum area for the resin to bond a given volume of glass. Since the strength of the resulting sheet is dependent upon the amount of reinforcement contained, it was postulated that the amount of glass could be increased due to the ability of the flakes to "pack" more closely and that the bonding area could be increased for a comparable volume of glass.

As a corollary of reason number two as described above, the packing could result in thinner and therefore stronger adhesive bonds.

The fourth postulate was that since the flakes would have fewer degrees of freedom, a stiffer laminate could be obtained.

It was reasoned that the flake might be cheaper for two reasons. The first of these is that no weaving would be involved and the cost of this operation would therefore be eliminated. The other reason is that more pounds of material a day can be forced through a slit than can be forced through a fine orifice.

The final reason for this investigation was the major difference between the theoretical inherent strength ascribed to glass and the actual values obtained from fibers. It was felt that this difference allowed ample room for improvement.

One advantage not originally considered but which has later been established to a limited extent is the resistance of flake laminates to penetration. This penetration may be by moisture, chemicals, sunlight or even ballistic particles. Since the voids between particles are smaller than for fibers (in a well prepared laminate) and since the successive plates tend to reinforce those initially attacked, improved resistance to penetration appears logical.

Discussion

Data showing some of the properties of flake glass laminate are shown in Table I. In this table we have compared properties obtained on flake glass laminates with more commonly available laminates. It may be noted that the flake laminate has three outstanding properties, glass content, stiffness, and low cost. More recent work has shown that the glass content can be raised to 85% by weight without undue difficulty. This compares with a maximum of 65% for most types of fiber constructions. The stiffness of the flake laminate exceeds that of all types of fiber construction except for the unidirectional cloth and in some cases we have gotten a 6 million psi modulus for flake laminate. The only material that can approach the flake laminate in material cost is the mat laminate and it is inferior in all measured properties. In spite of the use of the more expensive epoxy resin, material cost for flake laminate is only 50c per pound and, with the predicted lowering of the cost of the flake to 14c a pound, material costs will drop to 27c a pound. This would open up many new fields of application if the expected cost can be achieved. While the expected increase in strength has not been attained, it is possible that better techniques may improve the strength of flake laminate. However, even if improvements in strength are not possible, there are applications where the presently attainable strengths would be accepted in order to get the high moduli.

One omission in the figure is the failure to include the materials called "gunks" or more properly, molding compounds. These molding compounds are normally inferior in all mechanical properties to the presently available flake laminates and are especially disadvantageous because of their moduli of 0.5 to 2.0 x 10^6 p.s.i.

Experimental Results

I would like next to discuss some of the findings from the contracts which the Ordnance Corps sponsored with Linden Laboratories, Emhart Manufacturing Company and Armour Research Foundation. These findings may be divided into the general areas of the flake, the resin, the combination of flake and resin to form a laminate, and miscellaneous findings.

In connection with the flake, it was established that decreased thickness of the flake led to increased strength. This behavior is similar to the behavior of glass in fiber form. However, no experimental method was found to establish which of the theories put forth to explain increased strength with decreased area is valid.

It was found that the optimum ratio of area to thickness lies between 25 to 1 and 100 to 1. Below a ratio of 25 to 1, the laminates were weak, one possible reason being that the flakes were less perfectly aligned. Above 100 to 1, too much trouble was encountered in trying to remove entrapped air.

The composition of the glass offers less of a problem at the present time than does its geometrical structure. Later, of course, it may become evident that one specific glass composition offers advantages over other compositions. The glasses tested showed equivalent strengths in media of water, air and lubricating oil.

It was felt that strong flakes could not be obtained without either removing scratches on the flake surfaces or the effects of these scratches. However, etching the flakes with hydrofluoric acid to reduce stress concentrations resulted in a weaker laminate. It is believed that the lower strengths were the result of an excessive anion concentration on the flake surface which hindered proper wetting of the resin.

Several methods for making thin, flat and uniform glass flake were investigated. While one of these yielded very small quantities of flake for preliminary work, none is satisfactory for continued use. One laboratory procedure is still being investigated and will be mentioned again in a description of future work. In the meantime, commercially available glass flake from Owens-Corning has been used to prepare sample laminates. This material has been approximately 8 microns thick. Flake which is one-two microns thick has been made available very recently. However, this has not been made into laminates yet.

Effect of Resin

Findings in connection with resins will be discussed next. Originally, polyesters were tried but were unsatisfactory primarily because of their lack of wetting on unfinished surfaces and their relatively high shrinkage. While several different thermosetting and thermoplastic resins were tried to a very limited extent, practically all of the work was confined to the epoxies. An epoxy-polyamide combination (specifically Shell 828 and Versamid 125) gave some of the better results. It was found that the resin can be unsatisfactory if either too viscous or too fluid. Highly viscous resins make bubble removal difficult while a resin which is too fluid results in poor microstructure as it flows around clumps of glass rather than carrying the flakes to an area of lower concentration. While no finish has been used on the glass flake because of the extremely good wetting ability of the epoxies, it is not known that the properties could not be further improved by use of the proper finish. It is certainly reasonable to expect that retention of strength under conditions of extreme moisture could be improved by the proper finish.

Earlier adhesion studies had led to the belief that the thinnest glue line is the strongest and the belief was verified in this case. Glass rods with butt joints were tested and it was found that when the resin layer was less than 20 microns, failure occurred almost exclusively in the glass rod. A glue line exceeding 80 microns led to failure through the resin layer. When the glue line was between 30 and 70 microns, the type of failure was less predictable. The load sustained by a 20 micron resin layer was twice that obtained when the resin was increased to 50 microns thick.

Table I
Mechanical Properties & Economic Considerations

Reinforcement Resin	Glass Fabric Bi-Directional-Type 181 Polyester	Glass Fabric Uni-Directional-Type 143 Polyester	Glass Mat Polyester	Glass Fabric Bi-Directional-Type 181 Epoxy	Glass Flake Epoxy
Glass Content, % by Weight	60-65	62-67	35-45	66-73	75-80
Strength, P.S.I. x 10^{-3}					
Flexure	50-60	85-105	25-38	65-77	40.
Tension	40-48	78-86	15-23	50-60	20.
Modulus, P.S.I. x 10^{-6}					
Flexure	2.3-3.1	4.5-5.5	1.0-2.0	3.0-4.0	4.0-5.0
Tension	1.8-2.8	4.0-5.0	.8-1.8	3.0-4.0	4.0-5.0
Impact, Ft.-Lb./In., Unnotched	20-27	50-55	13-21	18-25	———
Hardness, Barcol	60-70	———	50-55	———	65-75
Price, Reinforcement, Lb.	$2.00	2.00	.40	2.00	.40*
Price, Material, Lb.	$1.40	1.40	.40	1.65	.50

Many of the Glass-Fiber Data Taken From "Fiberglas Reinforced Plastics" by R. H. Sonneborn, Reinhold Publishing Corp., N. Y. (1954)
*Reduction to $.14/Lb. Predicted

Two experiments were carried out in which the flake-resin combination was mixed and then allowed to stand at the B-stage or pre-mix stage. In one case, the material was stored at —5°C and in the other case at room temperature for several days. Resulting laminates were not adversely affected.

The pay-off toward which we are working came nearer when the facts discovered about the flakes and the resins were combined to help us get a laminate. Several advantages were gained from increasing the glass content. First and foremost, increased glass content meant greater rigidity or stiffness. In addition, the higher content meant better alignment of the flakes. Furthermore, increased glass content meant that the glue lines were decreased, again contributing to the strength. The micro structure also improved with increased glass content since there were fewer "resin pools" or unfilled pockets.

In the miscellaneous category, combination laminates were prepared on a limited scale. One of the combinations consisted of a fiber-flake laminate. Very little advantage was gained when a layer of flake laminate was prepared with a layer of fiber laminate on each side of it. However, when the fiber layer was sandwiched between two flake laminates, the resulting laminate was a little better strength-wise and considerably better from the modulus viewpoint. This latter laminate was also a little better than flake without any fiber strength-wise with an equivalent modulus.

Another combination tried was a glass flake-cellulosic laminate. The glass was deposited upon Kraft paper and these sheets were laid up to form a laminate. This resulted in a simpler lamination procedure but quite adversely affected the strength and modulus. At present this does not look promising except for applications where lower property values are acceptable. However, if a sacrifice in properties can be made, this process should lend itself to economical production. Flexural strengths of 19-30000 psi and moduli of approximately 3 x 10^6 psi were obtained by this procedure.

Table II depicts values obtained on preliminary laminates prepared at Picatinny Arsenal. These laminates were made of Owens-Corning Flake glass and the epoxy-polyamide mixture as described before. Glass content was calculated to be 80% by weight for all except the bonding strength specimens. In the latter, the glass content was 70%.

Table II

Data Obtained on Glass Laminates 8-Jan. 57

Tensile Properties	Strength	Elongation	Modulus
ASTM Type I	P.S.I.		P.S.I. x 10^6
Specimen- .2"/Min.	14,600	.27	5.93
High Rate 6.5			
Milliseconds	41,100		
Flexural Properties			
Tested Edgewise			
¼" x ¼" x 5"			
Crosswise	31,400	.070	5.14
Lengthwise	30,600	.074	4.95
Tested Flatwise			
½" x ⅛" x 5"			
Crosswise	31,200	.034	4.99
Lengthwise	31,200	.035	4.76
Bonding Strength	2,640		

Table III

Vibrating Reed Data on Laminates

	Flake	Commercial Polyester #1	Commercial Polyester #2
E^1 (Elastic Modulus) P.S.I. x 10^6	12.7	3.0	4.4
E^{11} (Viscous Modulus) P.S.I. x 10^4	18.	2.3	3.6
Tan. δ (Mechanical Dissipation Factor)	.014	.0075	.0083

Tensile Strengths

It will be noted that the tensile strength obtained is lower than that shown in Table I, being 14,600 psi as against the former 20,000. However, the modulus increased from a range of 4 to 5 to 5.93 x 10^6 psi. The flexural properties were determined both edge-wise and flat-wise. Edge-wise and flat-wise specimens were tested both cross-wise and length-wise to see if the anticipated isotropic properties were really achieved. These data show that the materials are isotropic even beyond expectations. The moduli obtained are close to the upper limit shown in Table I. It should be noted that values obtained on thinner specimens will be falsely encouraging, a modulus of six million being readily obtainable on a specimen only slightly thinner than the standard ⅛".

For purposes of comparison, a commercially available fiber-polyester laminate was run in flexure. The strength of this laminate was over twice that of the flake (67,800 psi as compared to 31,000 psi) but the modulus was only 3.3 x 10^6 as compared to 5 x 10^6.

Since a high rate tensile tester was available and since polymeric materials vary markedly in their sensitivity to rate of testing, a tensile test which took the specimen to fracture in 6½ milliseconds was run. The measured strength increased nearly three times to 41,100 psi.

It was expected that the bonding strength of flake laminate would be superior to that of fiber laminate. Since no commercially made fiber laminate was available in ½" thickness, a laminate was made up in our labs using 181 cloth and the epoxy-polyamide mixture. However, while the flake laminate required a load of 2640 psi to cause delamination, the fiber laminate required 4470 psi. In both cases, the failure appeared to be in the resin layer. No explanation of these data is offered at this time.

In our labs we have an apparatus known as the vibrating reed which allows the determination of a complex modulus which can be broken down into the elastic and viscous components. We also get the ratio of viscous to the elastic component which is the mechanical dissipation factor. For those not familiar with this equipment and desiring further information, it was described in the May 1956 ASTM Bulletin. This equipment was used to determine the material constants on two commercially available laminates in addition to the flake laminate at approximately 140 cps. These data are shown in Table III.

It can be seen from these data that the E^1 or elastic modulus is very much higher for the flake laminate than the fiber laminates. The value of 12.7 x 10^6 is four times higher than commercial laminate #1 and three times

(Please turn to Page 70)

Advantages of Dual Thermocouples

In Injection Cylinders and Extrusion Barrels

Richard K. West

West Instrument Company

THERMOCOUPLE location is of prime importance in proper control of either injection molding machines or thermoplastic extruders. There have been numerous papers given on this subject dealing with the advantages of locating the thermocouple at different depths through the heating cylinder or extruder barrel. Actually there can be no single depth proper for all conditions of operation to the maximum advantage of the machine user.

In view of the conflicting characteristics of the thermal system in either of these thermoplastic processing machines, a device has been incorporated in the plastic machines which has proven itself in other thermal problems such as in ovens and furnaces. The device is the dual thermocouple which is illustrated in Figure 1.

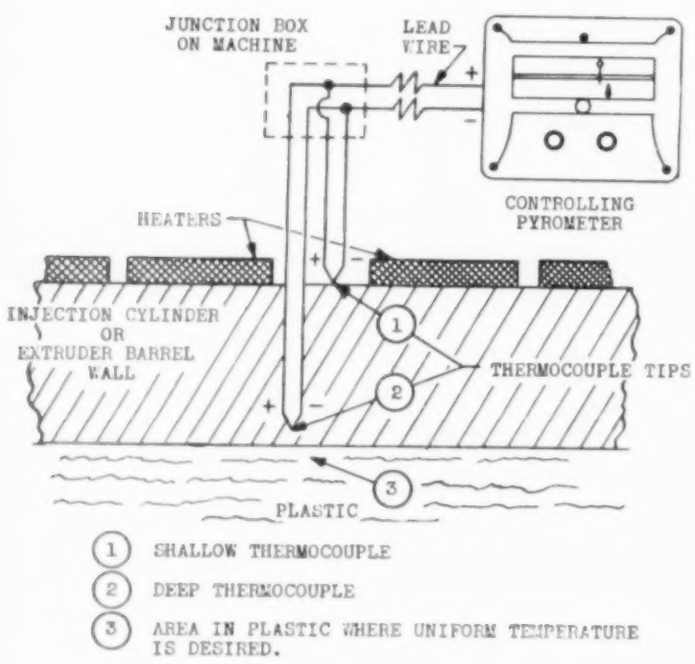


Figure 1. Physical and electrical arrangement of dual thermocouples

Figure 1 shows a section of the cylinder wall of either an injection molding machine or thermoplastic extruder with the heaters on the outside of the wall and the plastic on the inside. We will continue to refer to this representative section which is also representative for heating problems that occur in compression molding machines and transfer molding equipment, as well as in injection and extrusion machines. In the illustration the controlling pyrometer is normally mounted in a control system cabinet either adjacent to the machine or possibly on a nearby wall or post. The lead wire going from the instrument to the machine is connected at a junction box on the machine to the thermocouples themselves, and the thermocouple tip or tips are located either deep in the wall, shallow in the wall or in some cases even in the heaters themselves. Our principal concern is to control the input from the heaters to provide at all times a constant temperature at point 3, which is in the plastic material within the heating zone. Figure 1 illustrates the application of a dual thermocouple. There is a thermocouple located at point 1 which is on the surface, and another one located at point 2 which is deep within the wall. These two thermocouples are connected in parallel at the machine junction box from which point the millivolt output of the thermocouples is led to the controlling pyrometer through a single set of lead wires.

This arrangement under conditions of actual operation results in approximately averaging the temperature between points 1 and 2. This is possible due to the nature of a thermocouple as a generating source, since it is in itself resistance free at the source. This has been proven in the laboratory under controlled conditions. The reason for referring to this as an approximate average is due to the fact that we are actually measuring millivolt output from the thermocouples, and since the temperature vs. millivolt distribution is not entirely linear, we would therefore not expect to have completely accurate averaging of temperatures. For practical purposes the averaging would be within a couple of degrees, and therefore any inaccuracy referred to is only of academic interest, as normally one cannot read the instruments this closely.

In considering the relative merits of different positions of thermocouple location, we must also consider the function of the machine at the time. One of the conditions of machine operation that we are obviously concerned with is warm-up or initial start-up of the machine.

Figure 2 showing the same control zone with a single shallow or surface thermocouple is representative of the actual installation on many machines. The theoretical basis for this installation is that proper control of the temperature at its source by frequent pulsing will permit an even flow of heat from the heaters to the plastic. The temperature at the heaters as reflected on the pyrometer is higher than the desired temperature, and this is due to heat losses away from the machine outwardly, as well as the cooling effect of plastic passing on the inner wall. The temperature of the heaters may be held fairly constant as the thermocouple senses temperature changes rather quickly; consequently, it is possible to obtain a fairly uniform temperature at point 3 in the plastic. The warm-up time is long, as the heat input at point 1 must necessarily be adjusted for conditions of operation rather than conditions of warm-up, and for this reason the rate of warm-up as shown at point 3 on the graph is slow. From the standpoint of not overheating the plastic at point 3, this is a very desirable installation and is superior to that shown in Figure 3.

Warm-up Conditions

In Figure 3, the thermocouple is located at point 2, which is presumably as deep in the wall as it can be located without weakening the inner wall and causing a fracture due to the plastic pressure. It should be pointed out that point 1 and point 2 represent two extremes of thermocouple location, although actually these two extremes have been used in the design of some machines. Compromises in thermocouple location between point 1 and point 2 would, of course, have some of the features of each of these extremes, but there is no possible single location that would have the advantages of both without also having some of the disadvantages of both of these two extreme locations. The graph below Figure 3 shows that the temperature at point 2 rises far above the desired control point. Also, the temperature at point 3 rises above the temperature desired at the plastic, and this may be detrimental in molding some materials such as vinyl by causing decomposition. The extreme temperature variation shown on the dotted line representing the temperature at the thermocouple is due to the fact that the instrument may shut off the heat input from the heaters only upon reaching the control band of the instrument. As we know, proportioning type controllers improve this situation, and this is illustrated on the graph by the diminishing width of the cycles; however, the fundamental reason for the wide variation is that the heat input requires time to penetrate the steel wall and reach the thermocouple tip, and even though the instrument may turn off, there is still a large heat capacity stored within the wall passing from the heater to the thermocouple. The same extreme is also noted on the cooling cycle, as cooling from point 3 due to the passage of plastic must affect the thermocouple at point 2 in overcoming the excessive heat that was present, and again, the time factor results in rather excessive temperature variation, which is not considered to be desirable. The fluctuations dampen out and, in approximately the same time that the shallow thermocouple shown in Figure 1 established a uniform temperature, an approximately uniform temperature has been established with the deep thermocouple as shown in Figure 3.

Referring now to Figure 4, the conditions for warm-up with dual thermocouples installed represents what we would expect and have found experimentally and in production with this type of installation. Here we

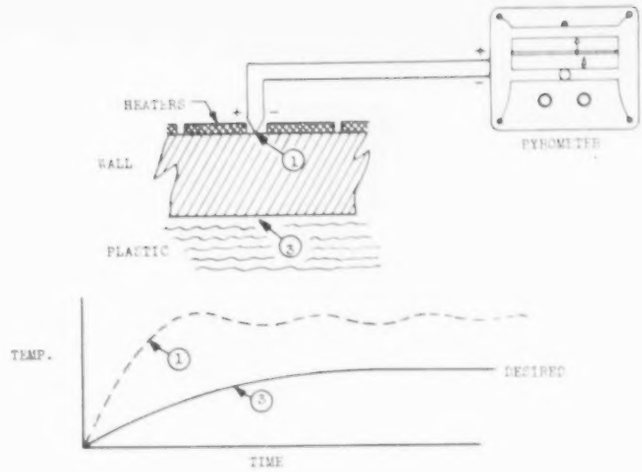


Figure 2. Warm up—Conditions for shallow thermocouple only

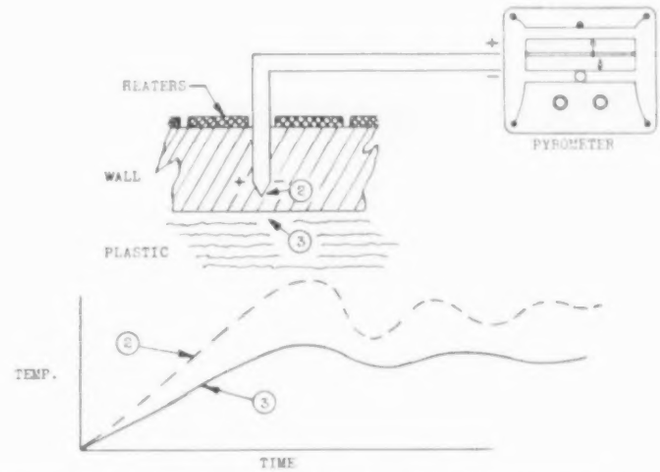


Figure 3. Warm up—Conditions for deep thermocouple only

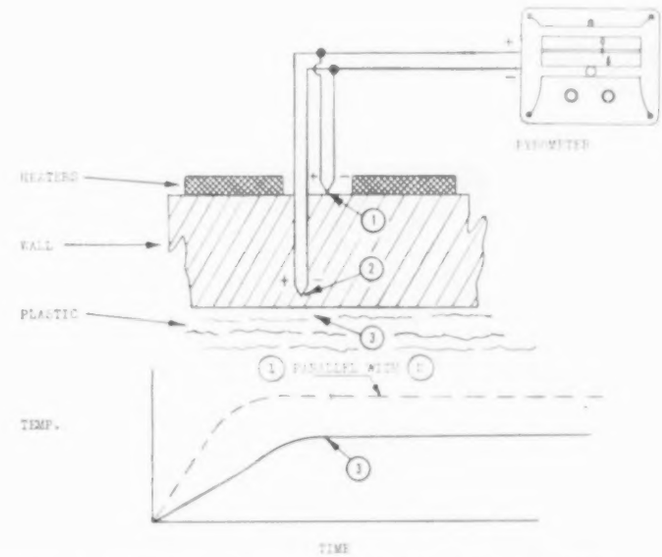


Figure 4. Warm-up—Conditions for dual thermocouples

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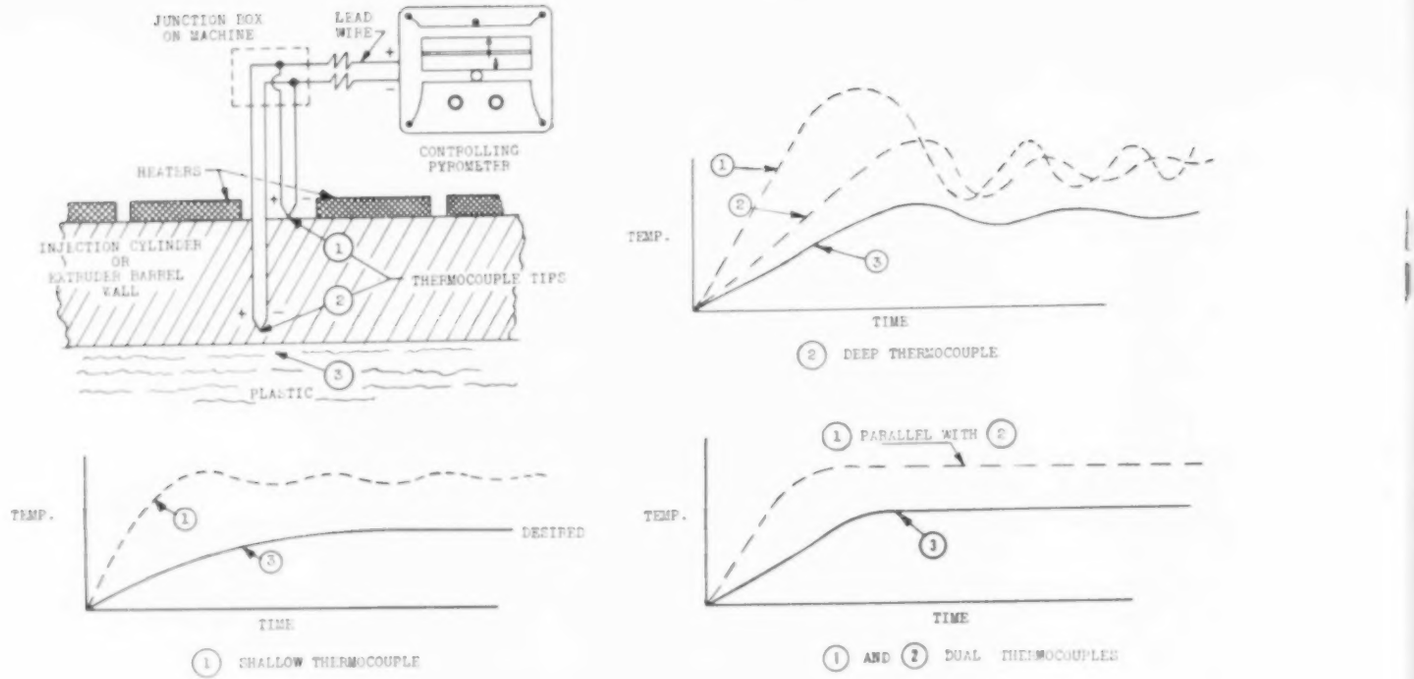

Figure 5. Comparison of warm up

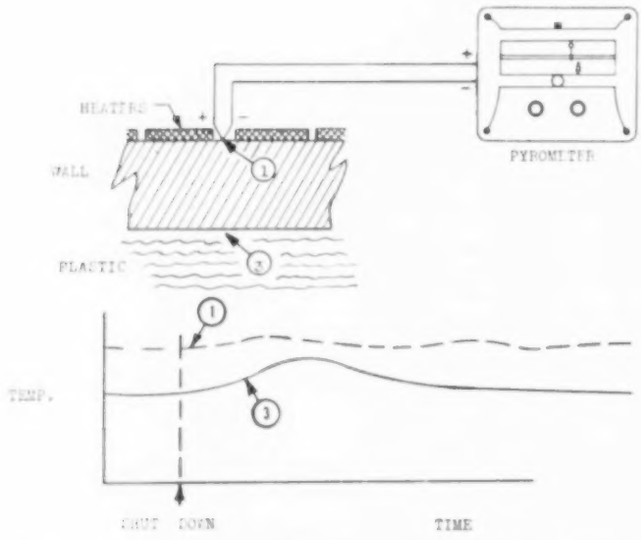

Figure 6. Shut down—Conditions with shallow thermocouple

find that, with thermocouple 1 and thermocouple 2 connected in parallel, the temperature at point 3 becomes stabilized much earlier than under either of the previous conditions. The combined thermocouples would produce on the instrument a temperature reading representative of the two outputs averaged, which is illustrated on the graph as reaching stability much earlier than the deep or surface thermocouple locations alone.

In Figure 5 ,we have repeated the drawing arrangement shown in Figure 1 and have also shown the three conditions of thermocouple location with their separate graphs. In this figure, you will notice temperature is stabilized under the conditions of the dual thermocouple in approximately one-third of the time required with either a shallow or deep thermocouple. With a shallow thermocouple installed there is no danger of over-shooting the desired temperature at point 3 so that this condition is actually superior, from the standpoint of protecting the plastic, to the deep thermocouple which does permit overshooting in the plastic. The slope of the plastic temperature, as shown on these three graphs marked with a "three" in a circle, is equivalent on both the deep thermocouple and the dual thermocouples combined except that as the desired operating temperature is reached with the dual thermocouples there is a decrease in the rate of heating which permits the temperature to stabilize without overshooting. This is due to "rate action," which is a term applied in the instrument field to indicate that the heat input has a relationship to the offset of the actual temperature from the desired operating temperature.

Let's pause for a second and see how this happens in an installation where dual thermocouples are used. The temperature at Point 1 starts to produce millivolts at the shallow thermocouple as soon as the power is turned on the machine, as this location immediately senses the heat input. The deep thermocouple at Point 2 is insulated from the heaters by steel with its inherent slow rate of heat transfer; consequently the average of the cold thermocouple at Point 2 with the warm thermocouple at Point 1, with a fixed temperature setting on the controlling pyrometer, the effect is that operation at a higher temperature is possible at Point 1 than would be if this thermocouple were connected alone. As the temperature climbs to the desired operating value at Point 3, heat will gradually penetrate to the thermocouple at Point 2, and as it approaches the desired temperature at Point 3 the added millivolt output from the thermocouple at Point 2 will, in averaging with Point 1, have the effect of reducing the amount of temperature at

Point 1, since the set pointer on the instrument is still at the desired operating temperature. We find, therefore, that the heat input from the heaters may initially be the maximum output of the heaters, but as the indicated temperature on the instrument approaches the control point, the true temperature of the heaters will be gradually reduced to that required to accommodate the combined requirements of thermocouples 1 and 2, which in turn, is the point at which the heating zone will stabilize itself and be ready for normal operation. This is a condition of inherent stability that is very desirable to obtain.

Another condition which is important in machine operation, perhaps the most important of all conditions, is the matter of returning to stable operation after the machine has been stopped and is out of its regular cycle. The same conditions apply to plastic processing machines, particularly extruders, when internal friction produces heat in the plastic due to pressure and flow. Figure 6 represents a shallow thermocouple as was shown in Figure 2, and you will notice that the machine has been stopped after being in operation for sufficient time to have achieved stability as shown on the graph at either Point 1 or Point 3. When the machine stops, the temperature at Point 3 will start to rise since the cooling effect of the plastic is no longer present to the same extent that it was while the machine was in operation. There is a delay in this cooling effect reaching the thermocouple located at Point 1, and consequently the temperature at Point 3 may rise considerably before the instrument actually turns off power to the heaters. The temperature at Point 3 will rise perhaps above a safe point for the material in the cylinder or barrel. If the material is vinyl, decomposition may be expected. It is important to remember that this is beyond the ability of the instrument to correct, as the instrument is slow in sensing what has happened due to the temperature lag through the steel from the point of change in the plastic to the sensing element or thermocouple which controls the heating or cooling by positioning the temperature pointer on the instrument with respect to the control setting pointer. Notice that there is a long slope to line 3 in returning to normal operating temperature. This is due to the fact that the heat input at Point 1 is fixed, even after the combined external cooling outside of the cylinder or barrel and the internal cooling from Point 3 has affected the thermocouple at Point 1 and shut the heat off, the heaters are turned on again before the temperature at Point 3 has returned to normal.

Shut-Down Conditions

Figure 7 shows again the conditions of shut-down and this time it illustrates what might be expected with the deep thermocouple located at Point 2 as previously illustrated in Figure 3. In this case the thermocouple at Point 2 is quicker to respond to a change in temperature at Point 3 due to the small thermal mass that must be penetrated; consequently the amount of overshoot in temperature as illustrated on the graph at Point 3 is less, representing perhaps acceptable tolerances as far as the plastic is concerned. Due to the fact that the thermocouple at Point 2 is a long distance from the source of heat, it will again set up a cycling temperature pattern due to the thermal lag between the heaters and the thermocouple tip, and it will be once more a long time before the temperature at either Point 2 or 3 returns to a stable operating condition as it was before being shut down.

Figure 8 indicates the application of two thermocouples connected in parallel under the same conditions of shut-down as were described in the above two figures. In this case, the deviation of the combined thermocouples is less than that in the previous figures. The variation of temperature at Point 3 is more quickly sensed and corrected than it was in either of the previous examples.

Figure 9 again illustrates the three conditions with the graphs adjacent to each other. The machine controlled with the dual thermocouple is stable in approximately one-third of the time that either of the other thermocouple locations would permit. A very significant point on this collection of graphs is that the deep thermocouple is more desirable for the stable molding conditions, and in particular in preventing excessive overshoot than the shallow thermocouple would be. This is in direct contrast

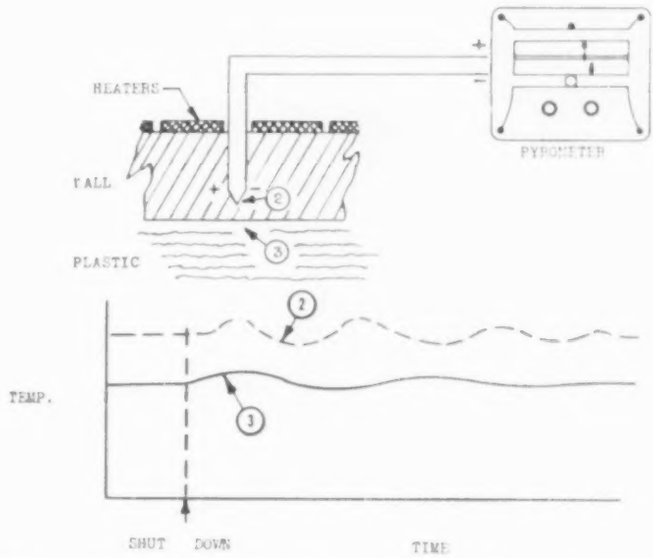

Figure 7. Shut down—Conditions with deep thermocouple

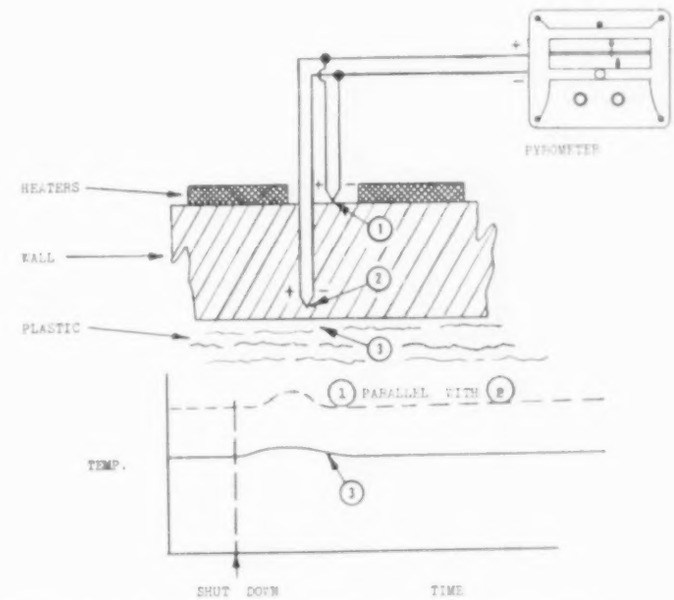

Figure 8. Shut down—Conditions for dual thermocouples

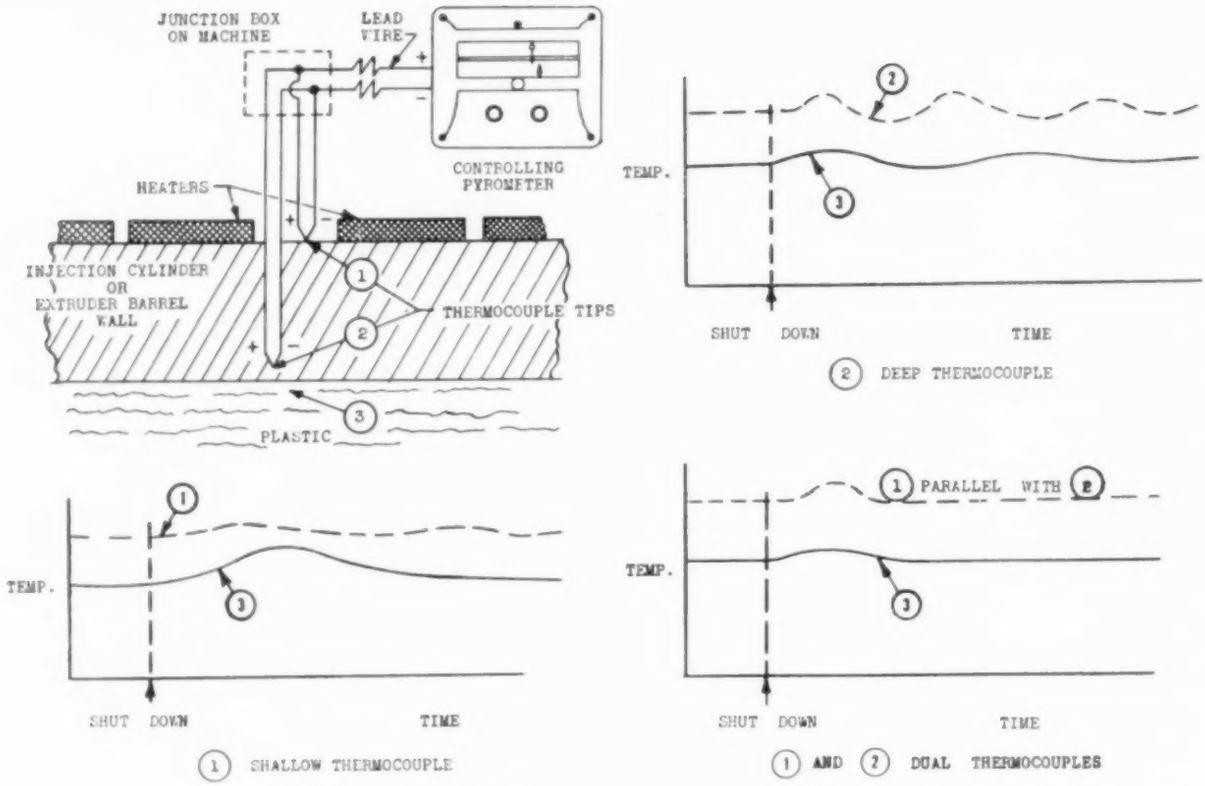

Figure 9. Comparison on temporary shut down

to the relative merit of these two thermocouples under conditions of warm-up where the shallow thermocouple represented safer operation. It is for this reason that the past discussions of thermocouple depth have occurred. It is not possible as mentioned earlier to satisfy both or all conditions of operation in a plastic machine with a thermocouple in either of these two extreme locations; however, under both of these operating conditions the dual thermocouples excel and are in no respect exceeded by the performance of the thermocouple in a single location.

As far as the indication on the instrument is concerned, the matter of averaging dual thermocouples need not be considered a draw-back for in the past thermocouples have been located at Point 1 or Point 2, and at various points between these two extremes. In each case, and with the dual thermocouples as well, the temperature indicated on the instrument will, under normal conditions, be above the actual temperature of the plastic, depending upon how far the thermocouple is located from the plastic. This is due to the heat lag through the steel and also due to the fact that the plastic passing the surface of the steel does not remain in this area long enough to absorb all of the heat at the wall. Ideally, it might be well to indicate on the instrument the actual temperature of the passing plastic; however, previous investigations have disclosed that even the thermocouples located flush with the wall do not show the true temperature due to a surface effect and deeper thermocouples located in the plastic beyond the well have been used only experimentally due to physical limitations on location and pressures involved.

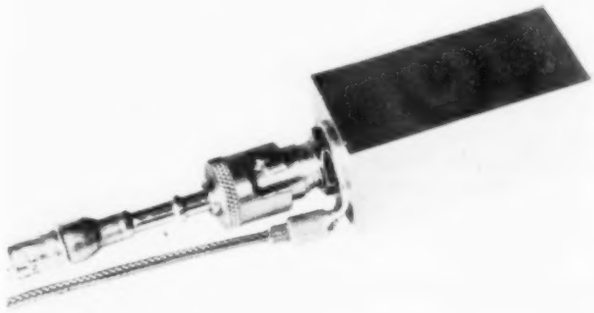

Figure 10. Complete assembly

While the temperature within the plastic is of extreme interest, it is not suitable as a control point for the instruments but might instead be considered as a reference point which might show on a separate indicating pyrometer instrument or recording potentiometer. The actual control of the temperature to achieve a uniform temperature in the plastic can best be obtained by thermocouples within the wall itself.

While the subject of dual thermocouples has been explained to isolated molders, and dual thermocouples themselves have been installed on many machines in practice, the difficulty of making this installation has certainly restricted the application of this rather basic

(Please turn to Page 68)

Editor Ernest Moslo

T. T. MILLER was named President of Polymer Chemicals Division in February 1956 when W. R. Grace & Co.'s newly organized division was formed to oversee operations of a new 50 million pound polyethylene plant now under construction in Baton Rouge, La. Main offices and customer application laboratories for the plant are maintained at Clifton, New Jersey.

Prior to this, Mr. Miller was with Dewey and Almy Chemical Company from 1922 to February 1956 as sales engineer, European Sales Representative, European Sales Manager, General Sales Manager, Vice President in charge of Sales, Vice President—Marketing, and then as Vice President of the Organic Chemicals Division. Dewey and Almy Chemical Company was merged with W. R. Grace & Co. in 1954.

Mr. Miller graduated from the Massachusetts Institute of Technology in 1922 with a B.S. Degree in Engineering Administration. He is a member of the American Chemical Society, American Marketing Association, Commercial Chemical Development Association, and Institute of Food Technologists.

He is Chairman of the Alumni Fund Board of M.I.T. His directorships include: Boston Fund, Inc.; Dewey and Almy Ltd.; London; Middlesex Products Co., Cambridge, Mass. Born in Orange, N.J. in 1900, Mr. Miller is married to the former Janet Hilton.

T. T. Miller

Steaming from Ships to Plastics

T. T. Miller

President, Polymer Chemicals Division
W. R. Grace and Co.

CHEMICAL PLANTS MAKE a hissing noise as hot gases and liquids rattle around in the maze of valves and pipes on their way to the reaction kettle. These noises of pumps and valves meaning something is being made under pressure are sounds similar to the roar and din one hears in the engine room of a sea going ship making about 19 knots and trying for more.

Such noises are familiar noises to men who work for the firm named W. R. Grace & Co. whether they are on duty in the engine room of a ship bound for an exotic port of call in South America or whether they are operating engineers looking at pressure gauges of Grace's newest venture in chemicals—the Polyolefin plant in Baton Rouge, Louisiana. Just how these noises got together and mixed into the same company is reflected in the entire U. S. economy today.

Everywhere firms are diversifying for growth purposes. Advertising agencies are adding public relations departments or marketing subsidiaries because they see an existing need or because they want to expand and not put all their eggs in one basket. Supermarkets sell socks, children's books and phonograph records alongside of the roast beef counter. Some independent research firms today will offer to develop a new rocket fuel for you; design the plant to build it in; offer your management new vistas in running the plant through operations research; and even locate the personnel to staff it. You can take almost any field or any firm today in any industry and find growth through diversification of different services and product lines.

As one company economist put it recently, "If the market for one of our products starts drying up we're spread far enough around so that the other lines will continue to provide income while our research and development program will come up with more new products to fill the gap—and who knows, tomorrow's products are probably on the drawing board right now."

W. R. Grace & Co. is probably not as well known as its famous subsidiary, the Grace Line. In fact, when we say work for a division of W. R. Grace & Co., we expect a blank stare unless we qualify our statement by casually saying, "you have no doubt heard of the Grace Line."

Just how we sailed from ships to chemicals and plastics started in the late nineteen forties.

In 1945, the net fixed assets of the firm were 61% in the steamship business; 32 in Latin American industrial and commercial activities; and 7% in various domestic businesses in the United States, in addition to our interests in the Grace National Bank and Pan American Grace Airways. While we were thoroughly and soundly diversified in Latin America, we lacked participation in growth industries in the United States, which is a pretty good country to do business in, after all.

As we look back, we inaugurated studies that seemed endless. We literally looked at everything. We put our best people on the job as Company Project Number One. We hired new talent for the purpose.

We consulted with consultants. We burned the midnight oil. The consensus was that the greatest growth

potential lay in the United States chemical industry, and to that star we hitched our wagon.

The chemical industry attracted us because it has enjoyed an 11% average annual rate of growth since the war, compared with 5% as the average for all industry. A very important reason for this is that the chemical industry spends on the average 3% of its sales dollar for research, while industry as a whole spends closer to 1%. Lionel Edie has called research "the built-in economic stabilizer."

Industry Analyzed

In 1952, after we had decided to enter the chemical industry, we set up what corresponds today to a commercial chemical development department. We hired engineers, chemists, market researchers, economists and financial analysts for our staff.

These men took a task force approach to the problem. They were somewhat reminiscent of the sailor in the A. A. Milne poem who was shipwrecked on an island and wanted a hat, some water and food, some housing and clothes, but didn't know what to do first.

The approach they used, however, was not to bask around and wait to be saved.

They categorized and classified the entire chemical industry by breaking it down into segments. This in itself was a momentous approach and required considerable road work in getting to know the entire industry better.

In many respects a large part of these earlier studies were justified for their educational benefit to our top management in giving them a general feel of the industry they were facing. It soon became apparent that it was far easier to identify the attractive segments of the chemical industry than it was to find an avenue of entrance. We did not have a sufficiently large existing industrial enterprise in the United States to provide us with some of the general logical bases for the entry that various other important companies had used when they decided to diversify into chemicals.

We could not enter through the systematic upgrading of waste by-products.

We could not enter the chemical industry in the way the petroleum companies did, through capitalizing on the chemical richness of their industry's by-products—nor could we do it through the research genius which enabled the explosives companies, du Pont, Atlas, Hercules, to broaden the chemical base of their existing industry.

Alternative Entries

The alternative methods of entry into chemicals that seemed to exist were:

(1) asquisition of existing chemical companies,
(2) the construction of plants based on licensing already developed processes available through engineering companies,
(3) initiation of a large research and development organization and the eventual commercialization of results therefrom.

After considerable discussion over the best of these alternatives, it became apparent that no single one represented the answer, but, rather, a combination of all three became the ground-work of the general plan. The emphasis in the earlier years was to be on acquisitions. As we developed a position in the chemical industry, the construction of new plants based on purchased processes became practical. Subsequently, the development of our own large research staff could form the major base of our growth in the years ahead.

Text-Book Approach

Our people then started a text book approach to the next phase of the problem. A variety of chemical opportunities were studied on which we could base new chemical ventures. As these were further screened, a thorough analysis of profitability was made, using the classical approaches which included:

Market Studies
Engineering Studies
Plant Location Studies
Customer Studies
Transportation Studies
and so on

These studies were embodied in two sets of reports. One was a preliminary report which covered everything the long report did, but with guesstimates supplied where details were lacking. Then, if the chemical was not washed out because of lack of profitability, a thorough analysis was undertaken that would do credit to any psychiatrist, his patient and couch.

In effect, we studied everything that might be deemed a growth segment, and the route was painstaking, severe and time consuming—particularly so when you are in a rush to get started.

Having reduced the various alternative investment possibilities to a dollars and cents evaluation, only then were we ready for the really difficult job. At that time antibiotics proved to be one of the most attractive end-products we might make, but how was Grace going to do this five years ago? Of course, we also found that the most attractive projects were the most expensive, in the sense that a good chemical company would only join up with us on a high price-earnings ratio. Also we found that almost any growing chemical product which could be entered by purchasing an available process shows only a modest profitability after competition intensifies. In short, the profitability figures of the various alternatives had to be compromised with a realistic appraisal of what we thought we could handle. We had to postpone some of the more glamorous projects until we had built up a chemical organization, and we had to settle for a more gradual stable entry into the chemical industry.

In 1952, when we decided to make ammonia and urea, we knew it was only modestly profitable, but at least these nitrogen products did not seem to exist in another world technologically. In effect, we were getting our feet wet in a growth segment of the industry where most profitable expansion could be undertaken once we had an ammonia and urea plant that had completed its shakedown cruise.

The Polyethylene Project

Today we are well along the way we originally set out to follow. Our present new polyethylene project, a 50,000,000 pound plant in Baton Rouge, Louisiana, while it still represents the purchase of an available process, nevertheless requires considerable research and development by us for successful commercialization. Grace is now staffed to be able to do this.

As for the more advanced stage of Grace's development, namely, the creation of new products completely within our own research and development, we have advanced quite far in the organization of our central research and development division, which is now in the final planning stages for construction of its new research center.

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Edited by Louis Paggi, *E. I. du Pont de Nemours & Co., Inc.*

Adjusting the Cylinder for Good Control of the Temperature of the "Shot Zone"

Louis Paggi

The **"shot zone,"** as considered here, is that part of the plastifying cylinder of an injection molding machine containing the molten plastic that is to be injected into the mold. The volume in the shot zone is equal to the rated capacity of the machine. In an 8 ounce machine, for example, the volume in the shot zone is the forward 8 ounces of plastic in inventory in the plastifying cylinder and in the nozzle.

It is, of course, necessary to control the temperature of all the zones of a plastifying cylinder as closely as possible. However, particular emphasis should be placed on the control of the shot zone temperature, since non-uniform temperatures may lead to a number of the following molding problems:

1. Displacement of mold cores, especially in deep-draw and thin-walled items.
2. Inability to hold dimensional tolerances.
3. Local flashing or short-filled cavities.
4. Poor physical properties of the molded piece.
5. Ejection difficulties confined to a few cavities.
6. Excessively long cycles.
7. Local crazing and other surface defects.
8. Excessive material consumed to flush out colors or a material of different formulation or composition.

The "shot zone" thus becomes the point at which the most sensitive and accurate instruments are required, and where the wattage distribution of the heater bands is most critical. The temperature of the molten plastic should be uniform through its cross-section and along the length and circumference of the "shot zone". Design of the cylinder plays a major role in attaining the required temperature uniformity of the cross-section of the melt and in general a cylinder design incorporating a thin cross-section at the "shot zone" is most helpful.

Uniformity in Zone

Uniformity of the peripheral heating at the "shot zone" is best accomplished by the use of narrow heater bands mounted in a staggered fashion so that the terminal gap between any two adjacent bands is at least 60°. Uniformity of temperature over the length of the zone often requires the use of heater bands of different watt densities. For example, when the spreader is rigidly attached to the front end of the cylinder, heat dissipation in the area where the spreader joins the cylinder will be higher than for the remainder of the "shot zone". As a result, the junction area will require a higher watt density per square inch of heater surface. The air gap (distance between adjacent heaters) in the zone should be held to a minimum to avoid successive hot and cold spots.

A relatively simple method of checking the uniformity of heat distribution in the zone is as follows:

1. Obtain a stick or rod of a material having a sharp melting point*.
2. Attach a surface thermocouple at some point near the geometric center of the zone. Commercially available washer or disc type thermocouples are excellent for this purpose. This thermocouple should be attached to the instrument controlling the zone temperature. The surface thermocouple may be eliminated if a kit of sharp melting point material covering a 150°F. range of temperature is available.
3. Starting with a cold cylinder, turn on heat to all zones.
4. As the temperature of the zone gradually increases, touch several points along the "shot zone" with the sharp melting point material. Repeat this operation approximately every one or two minutes until evidence of melting is noted at one point. At this time record the instrument reading. Continue to make periodic checks, with subsequent meltings and instrument readings recorded until every check point has reached the melting temperatures of the testing material.

Use of Data

The data obtained during this test can be used to balance the wattage over the entire area of the "shot zone". For example let it be assumed that one section of the "shot zone" is found to run considerably higher in temperature than another section, the wattage at the high point should then be reduced or vice versa. This can be accomplished by using bands of different watt densities, a rheostat, or a variable transformer in series with the bands. The latter method, although a little more expensive, is the most satisfactory.

It might be well to mention at this time that the above method of checking heat distribution in the "shot zone" may also be applied to check the performance of a single heater band over its entire circumference. It has been found that certain types of bands will not distribute heat uniformity over their whole area. This is occasionally due to shorting within the band, but is more often caused by faulty internal construction such as non-uniform contact of element with the insulation and casing of the band. It may also be due to poor local contact between the band and cylinder wall. Whatever the cause, it is well to keep in mind the possibility of inadequate heat distribution from the band when searching for causes of non-uniform cylinder temperatures.

The "shot zone" has been emphasized as the most critical because it is from it that the mold is filled. Other cylinder zones, although somewhat less critical, should also be well controlled if optimum results are to be obtained. It might be said that the zones containing the plastic in a melt phase require the most critical temperature control. It follows, then, that the rear zone is the least critical from the standpoint of temperature variability, except as it may affect pressure control and output.

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* *One source of this material is the Tempil Corp., 132 West 32nd St., New York, N. Y. It is available in a wide range of melting points. Other sources may be laboratory or scientific supply establishments.*

SPEAKING OF EXTRUSION

Edited by R. D. Sackett
Technical Service Associate
Monsanto Chemical Company
Springfield, Massachusetts

Extrusion of Rigid Vinyl

Jean F. Malone
B. F. Goodrich Chemical Co.

EXTRUSION OF RIGID VINYL compounds has continued to show vigorous growth in recent years. A large amount of credit for this progress must be given to the improved extrusion techniques that have been developed. Sufficient laboratory and production data have been accumulated so that reliance upon trial and error and personal skill has been largely supplanted by a body of sound technical knowledge. As a direct result, high standards have been established for pipe and tubing, and new markets have been encouraged in the field of custom extrusion. Although this review of extrusion techniques is based upon experience gained in the manufacture of rigid pipe, it can be considered generally applicable to other extrusion processes.

Raw Materials

Pipe can be produced from both vinyl powder mixes and granular compounds. In this country almost all commercial production uses granular or cubed compounds, but a great deal of European pipe is extruded from preblended powder. Producers here have found powder extrusion erratic. Good results are sometimes obtained, but it is difficult to maintain a consistent high standard. Considering this strong preference for rigid vinyl compounds, the data given here excludes all reference to the powder type of processing.

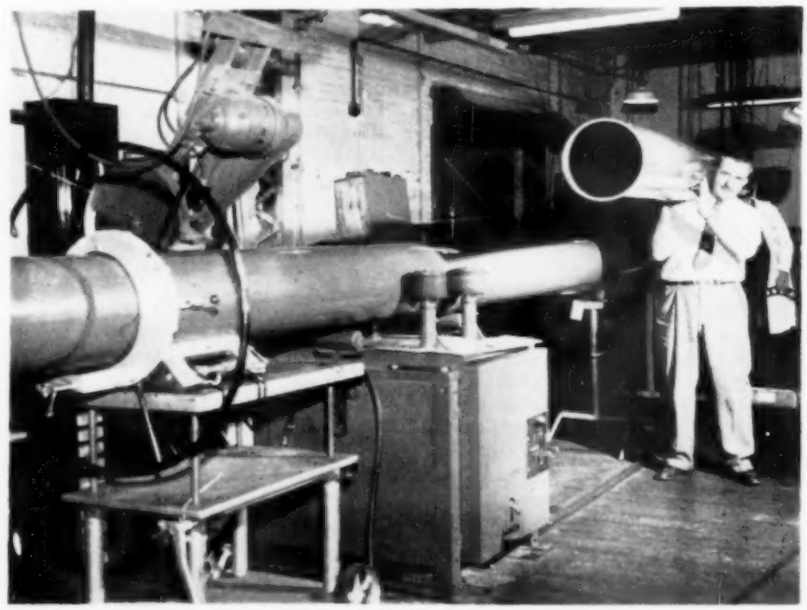
Operation

Manufacturers have determined that only minor adjustments of standard extrusion equipment are necessary successfully to extrude rigid vinyl pipe or to convert production to complex, specialized shapes. Satisfactory results can be obtained with both single and twin screw machines. Whether a twin or single screw is used, a typical production set-up consists of six basic units. They are the plastics extruder, the die, sizing equipment, cooling apparatus, pull rolls, and a sawing device. These units may vary somewhat in their method of operation but their function remains essentially the same. Definite recommendations for the operation of these units assist the producer in maintaining a high rate of production without sacrifice of quality.

The main unit of the extrusion plant is the plastics extruder. It must process the rigid vinyl compound by a proper combination of heat and work so that the stock is passed into the die in a homogenous, smooth-flowing mass. The cubes lose their identity after traveling approximately 1/3rd the distance along the screw. While passing through the middle section of the screw, the rigid vinyl begins to reach the proper stock temperature. A part of the heat is generated by friction, and supplemental heat is supplied by barrel heaters if it is found to be necessary. Volatile gases escape toward the rear of the extruder at this point. Final working in the last section of the screw should bring the stock to the exact extrusion temperature. The working must proceed for a given period of time to ensure the development of a uniform plastic mass that will flow easily into the die.

Constant Control

As outlined above it is apparent that effective extrusion can only be achieved through constant control of temperature. The build-up of frictional heat is the most critical factor in maintaining this control. Application of external heat must be carefully adjusted in reference to the frictional heat being generated during the working of the plastic stock. This controlled balance between two sources of heat must be held within a range of 5°F. An integrated system of temperature control points is essential to successful operation. The barrel of the extruder should have at least two points where thermocouple readings activate an adjusting mechanism. Temperature at the die is of the utmost importance and adequate control demands automatic, quick-acting control points on the lands, body, and adapter plate. The spider is usually sensitive to the die body regulation and requires no con-



This 12 inch pipe extruded by Colonial Plastics In Cleveland, Ohio, is a fine example of the quality that a well engineered production unit can turn out.

trol point of its own. A careful check of the die temperature is particularly important since the first sign of control trouble is frequently picked up by an over-riding of the die body temperature.

Equipment Design

Screws:

Many factors in single screw design contribute to the successful extrusion of rigid vinyl. The following characteristics have been found very advantageous:

- Full flight, constant pitch, and decreasing depth from entrance to discharge end of screw.
- Depth of flight should be deep—for a 2½ inch machine the depth at the discharge end should be 5/16ths of an inch.
- Ratio of length of screw to the outside diameter should be a minimum of 15:1.
- Compression ratio of approximately 1.7:1.
- Discharge end of screw should be shaped so as to prevent the formation of a dead spot in the flow of the plastic mass.
- Screw should be chrome plated and polished.

Proper operating RPM for a screw of the above design is usually low. Full production rates have been obtained in the range of 15 to 20 RPM. Normally rigid vinyl generates enough back pressure to make screen packs unnecessary, but at high production rates a breaker plate and screen pack (20-40-60 mesh) provide the best results.

Dies:

There are a number of basic principles that must be observed in the design of dies for rigid vinyl. They are based upon the inherent extrusion characteristics of rigid vinyl. Optimum rates of extrusion can be obtained only within a relatively narrow temperature range; a few degrees lower than the decomposition point. Even under ideal conditions the viscosity of rigid vinyl is sufficiently high to generate an unusual amount of frictional heat. A low rate of heat transfer further complicates the problem by inhibiting the escape of heat through the barrel walls. All these apparent difficulties can be minimized by a die that incorporates the following recommendations:

- Dies for rigid vinyl should be designed on a straight through flow pattern. Off set and cross head dies are not recommended.
- All obstructions to plastic flow should be shaped to produce a streamlined effect. Care must be exercised in such areas as spider approaches, spider legs, die land approaches, and the die adapter section.
- Die land length should be as long as possible. Dies having a wall thickness greater than .05 inches should have a land length 20 to 30 times that size. If the walls are less than .05 inches a shorter land length is indicated.
- All die surfaces coming in contact with rigid vinyl should be chrome plated and highly polished to improve flow and to impart a good finish to the extruded piece.
- Die openings are commonly sized precisely to the desired dimensions, but small shapes that vary in width are more easily extruded through openings that are somewhat larger than the finished piece. Sheet die openings are typically smaller than the thickness of the finished sheet.

Sizing and Cooling Equipment

Two methods are used for sizing extruded rigid vinyl compounds. The first uses positive devices such as sizing boxes, sizing rings, holding plates, and fingers. Dimensions are thus mechanically maintained until the product has cooled sufficiently to retain its shape and size. Another method employs only take-up and cooling equipment. The rate of take-up is controlled so that no sag or pull distorts the extruded piece. Both methods are being used commercially today.

In most rigid vinyl extrusion operations the sizing equipment is an integral part of the cooling system. Water and air cooling are both used, but water is much more commonly used. In water cooling the extruded article must be supported during its passage through the bath. Rollers, rubber rings, U troughs, and similar equipment have been used successfully. Thin tubes and some other custom shapes are cooled best in baths having an initial section in which the water is held at approximately 100°F. but generally baths are maintained at 80°F or lower. The length of the bath varies with the size of the extruded article. Small shapes extruded at comparatively fast rates require a longer cooling bath than heavier pieces. Large pipe, for example, needs only a very short cooling run before its shape and size are completely set.

Take-Up Equipment

The function of take-up rolls is to provide a steady pull that can be adjusted in small increments to match the rate of extrusion. A well adjusted take-up system will ensure the retention of proper dimension and prevent distortion that might otherwise occur. A series of motor driven traction rolls is preferred to most other forms of equipment. Variable speed drives powered by direct current motors are usually recommended. The speed controlling mechanism is most advantageously located near the die exit and just before the entrance to the sizing equipment. Care should also be taken to align the pull rolls on a horizontal and vertical plane that bisects the center of the die mandrel.

S.P.E. Committee on Encapsulation

Interested Members are Invited to Join

As a part of the Professional Activities Committee, a Committee on Encapsulation was formed during the recent SPE Annual Technical Conference in St. Louis, Mo. There were over thirty members present for this initial meeting The broad basic objectives agreed upon were as follows:

1. Attempts would be made to coordinate the work of this group with other similar groups already formed on encapsulation and embedment type problems. Groups currently in mind are the Military group which held a Symposium at Diamond Ordnance Fuze Labs. in January, 1956, and the group from SPE Southern California section which held a Symposium in November, 1956. Attempts would also be made to increase participation in this group. It was agreed that no standard testing programs would be undertaken by this group, since ASTM Committee D-9 is doing this work. There might be ways in which we could co-operate with D-9, however, such as providing written comments on their tentative procedures, which could help guide them in finalyzing a standard test procedure.

2. In addition to continuous interchange of ideas, an attempt would be made to have a greater number of sessions on embedment and encapsulation subjects at the annual SPE technical conference.

Since it is desired to pool information from as many sources as possible, increased participation in this group is desired. All information obtained for interchange among members will be disseminated to members of the Committee by multigraphed reports or through the SPE Journal.

Persons interested in joining this Committee, and who are willing to cooperate in sharing their experiences with others in the encapsulation field should submit, as early as possible, a listing of the areas in which he was interested, by virtue of present processes, development projects, general interest, or whatever; included would be not only problem areas on which he would like technical advice from the other members who had solved problems similar to his, but also a listing of what he could offer in terms of advice, problem solutions, or other technical assistance.

This information should be submitted to Charles A. Harper, Westinghouse Electric Corporation, Air Arm Division, P.O. Box 746, Baltimore 3, Maryland.

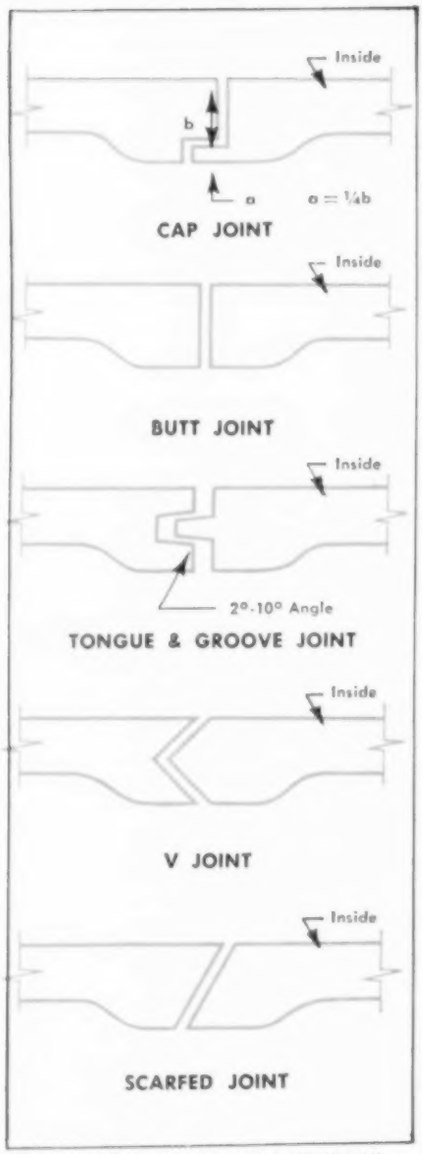
APRIL
1957

DOW

Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

PROPER BONDING OF STYRON PARTS REQUIRES THOROUGH STUDY OF ADHESIVES



TYPICAL ADHESIVE JOINT DESIGNS FOR STYRON

Design of the joint plays an important role in the effectiveness of the adhesive, the appearance, and the ease and cost of the assembly. Design also determines whether the adhesive will be stressed in tension or in shear when under load.

ADHESIVE JOINT DESIGN CRITICAL IN OBTAINING MAXIMUM STRENGTH, DURABILITY AND APPEARANCE

The design of adhesive joints for Styron® plastic assemblies is dependent upon a thorough knowledge of the solvent and chemical action of the adhesive to be used. Through Plastiatrics studies, under the direction of Dow Plastics Technical Service, exhaustive tests have been made on adhesives for Styron. With this information, plastics engineers can more intelligently approach the problem of adhesive joint designs.

Most common of the adhesives studied are the solvent types. They are classed, generally, as fast, medium, and slow drying. Choice of a solvent adhesive is governed largely by the requirements of the finished part. Factors such as appearance, strength and production time must be considered when selecting this type of adhesive.

Certain joint designs require more viscous adhesives. These are made by adding resins, plasticizers and other modifiers to solvents. These adhesives are used when better watertight or airtight seals are required.

Although the objective of the studies was to determine the characteristics of adhesives for Styron and test the effectiveness of various adhesive joint designs, other valuable data was collected. Toxicity of these solvents must be considered in order to protect those who work with them. In addition, various methods of adhesive application were examined.

Plastiatrics studies and research continue in this and similar areas in an effort to find practical solutions to problems in plastics engineering. Determining the desirable properties of adhesives for Styron is just one of a series of such studies. For your copy of the technical bulletin "Adhesives for Styron" and a list of other areas now under investigation, write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department PL1541J.

AMERICA'S FIRST FAMILY OF POLYSTYRENES

GENERAL PURPOSE
- STYRON 666
- STYRON 665 (Extrusion)
- STYRON 688 (Easy Flow)
- STYRON 689 (Easy Flow)

HIGH IMPACT
- STYRON 475
- STYRON 777 (Medium Impact)
- STYRON 440 (Heat Resistant)
- STYRON 480 (Extra-High Impact)

HEAT RESISTANT
- STYRON 683
- STYRON 700

YOU CAN DEPEND ON DOW

Action— By Your National Organization

"The objects of the Society shall be to promote in all lawful ways the Arts, Sciences, and Engineering Practices and Standards connected with the utilization of plastics."

SPE Objectives For 1957

President Simmons Outlines SPE Plans . . .

IT IS IMPORTANT that each area of activity within the framework of the Society has constantly before it set goals, so that we may be working with singularity of purpose. Outlined are the targets for each of the major activities of the Society for the year 1957. For the sake of simplicity the activities and target areas are set forth without a great deal of definition as they are for the most part self-explanatory.

The target dates have been set to coincide with National Council Meetings, so that action resulting from any phase of our activities can be carried out with dispatch. Obviously, such a comprehensive program cannot be carried out by a few, but its success will rely on extensive participation by a good share of the membership of the Society. Consequently, the achievement of our goals for 1957 will be a tremendous tribute to the entire membership.

Respectfully submitted,

Peter W. Simmons

Peter W. Simmons,
National President

The Targets for 1957 . . .

I. Membership Committee Activities:

1. Membership Increase:
   1,250 new members an increase of 24%—total membership 6400—January, 1958.
2. Decrease in Number of Delinquents:
   Decrease from present 6% rate to 4%—January, 1958.
3. Study on students interest and participation in Society's functions:
   Study by ad-hoc committee complete—June, 1957.
   Should study indicate an area of activity, appointment of permanent committee and work initiated—January, 1958.
4. Study of Resignations:
   Preliminary study and report available—April, 1957.
5. Membership survey and study:
   Questionnaire to be completed and distributed to total membership by May, so that tabulation may be started in July and preliminary report available—January 1, 1958.

(Please turn the page)

Targets for 1957 . . .

II. New Section Development Committee Activities:

1. Three new sections established for charter presentation—January, 1957.
2. Continue study on new areas of interest and report—June, 1957.
3. Study on sponsorship of new sections by established sections in close proximity—report ready June, 1958.

III. Finance and Auditing Committee Activities:

1. Preparation of the 1957-58 fiscal year budget—April, 1957.
2. Report on 1956-1957 fiscal year Budget vs. Expense—September, 1957.
3. Mid year report on Budget vs Expense—January, 1958.
4. Study and recommendation on standardization of Section Accounting Procedure—June, 1957.

IV. Credentials Committee Activities:

1. Closer working relationship between National and Credential Committee.
2. Constant up-grading through detailed study of applications and appendant information.
3. Study on conditional membership during period of processing—June, 1957.
4. Reduction in time necessary to process a member.

V. Constitution and By-Laws Committee Activities:

1. Preliminary discussion on major changes—April, 1957.
2. Complete revision ready for preliminary approval—June, 1957.
3. Revision ready for final approval—September, 1957.
4. Revision published and distributed to all members—January, 1958.

VI. Public Relations:

1. Study on the scope and responsibilities of this committee—June, 1957.

VII. Publications Committee Activities:

1. SPE Journal:
   a. Circulation — present circulation 5800 — total circulation 7500—January, 1958.
   b. Advertising space increases—30 pages per issue rate—January, 1958.
   c. Study of our recent move, relative to publication and editorialship—June, 1957.
   d. Devise means to reduce necessity of publication of conference papers as regular articles in the Journal—September, 1957.
   e. Study and recommendations relative to general format—June, 1957.
   f. Establish new features in keeping with Society standards but offering diversification to the reader—June, 1957.
   g. Written manual on procedures for revising and rating technical papers, June, 1957.
   h. Establish better public relations between Journal and potential contributors — April, 1957.

VIII. Meetings Committee Activities:

1. Publish Section Procedures Manual for *Antec* and *Retec*, June, 1957.
2. Mail 1963 Conference bids April, 1957. Study and recommend approval January, 1958.
3. Establish 1959 Technical Conference on West Coast in conjunction with Los Angeles Section.
4. Establish at least five Regional Technical Conferences during 1957.
5. Publishing of "Manual for Authors" of Technical Papers—1957, May.

XI. Education Committee Activities:

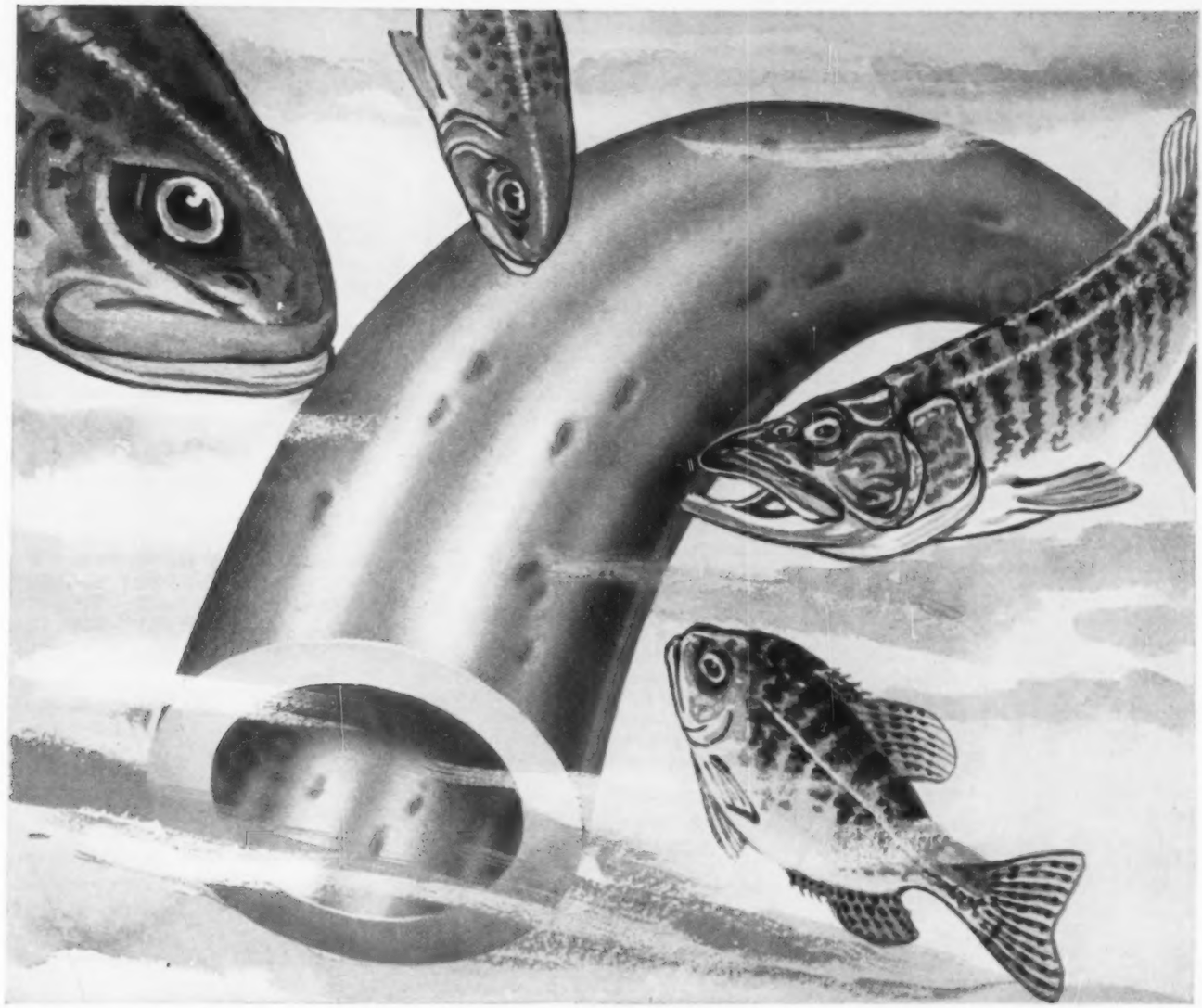
1. Completion of study on Technical Volume—April, 1957.
2. Increase in local section activities on education programs.
3. Preparation and publishing of a brochure on possible approaches to section educational activities September—1957.
4. Completion of SPE Educational Film—January, 1958.
5. Distribution of survey on courses in Plastics offered at universities and colleges in the United States—June, 1957.
6. Publishing and distribution of lists of books available on Plastics—June, 1957.

X. Technical Committee Activities:

1. Complete and publish revision of book, "Injection Molding"—January, 1958.
2. Complete and publish Engineering Volume II, "Thermoplastics Processing"—January, 1958.

IX. Professional Activity Groups:

1. Define scope of operation and establish working committees in eleven groups now approved—January, 1958.



FISH EYES are OK for FISH

But if "FISH EYES" caused by undissolved particles ARE A PROBLEM IN YOUR PRODUCT then a look at ESCAMBIA PVC 1250 may suggest an answer. This is Escambia's new straight PVC Resin with excellent processing characteristics INCLUDING freedom from "Fish Eyes." Another plus is Improved Heat Stability with its advantages in quality control.

Other new resins include:

ESCAMBIA PVC 1225—intermediate molecular weight resin particularly adapted for supported and unsupported sheeting.

ESCAMBIA PVC 1200—low molecular weight for flexible and rigid sheeting.

For additional information about Escambia's new resins—write the address below on your letterhead—

ESCAMBIA CHEMICAL CORPORATION

261 MADISON AVENUE • NEW YORK 16, N. Y.

NEWS of the industry

New A-D-M Resin, Plastics Division

Realignment of the resin sales organization of Archer-Daniels-Midland Co., Minneapolis, was announced today by W. G. Andrews, ADM assistant vice president and manager of the newly-formed resin and plastics division.

Named to the new position of assistant to the division manager was W. C. Mueller, while E. W. Kaufmann, formerly regional manager in charge of the territory served by the Philadelphia sales office, was appointed sales manager for resins.

Fred J. Burnett, former sales manager of Glyptal resins for General Electric Co. who joined ADM recently after it purchased rights to manufacture Glyptal resins, is sales manager for industrial resins.

To provide a closer link between ADM and its customers, four resin sales regions have been established.

Appointed supervisors of these new sales regions were Clyde C. West, Los Angeles; Earl Erlandson, Chicago; Gale Smith, Cleveland; and William R. Dodds, Newark, New Jersey.

The regional executives will supervise resin sales and introduction of new products in the areas served by ADM branch offices and agents as follows:

West in Los Angeles, San Francisco, Portland and Seattle; Erlandson in Chicago, Milwaukee, St. Louis, Atlanta, Memphis and New Orleans; Smith in Cleveland, Buffalo, Cincinnati, Pittsburgh, Detroit, Indianapolis and Louisville, and Dodds in New York, Cambridge, Philadelphia and Baltimore.

Molding Presses

Hull-Standard Corp. of Abington, Pa. is manufacturing a new line of fully-automatic, high-speed compression molding presses which feature an all-electric drive, a safety interlock system and a Quickset sequence automatic cycle control. The complete dry cycle time is 12 seconds, not including the "slow close" adjustment, which gives a range of closing speeds to meet plasticizing time requirements at various materials. The 75-ton Model 450-B press has a closing speed at 2.9 seconds and an opening speed at 2.7 seconds. The die area is 18" by 18¾". Platen stroke is 7".

Brushing Machine

A dual purpose mechanical brushing machine has been designed and produced by The Fuller Brush Company which may be used to either brush the top of a continuous web of plastic material, thereby improving its surface luster, or to brush conveyor belts while they are in operation, thus saving time and increasing production.

For detailed specifications: The Fuller Brush Company, Machine Division, Hartford 15, Connecticut.

Gering, Inc., Moves

The Chicago office of Gering Products, Inc. has changed its address. The new address is 5143 West Diversey Avenue, Chicago 39, Illinois. Telephone BErkshire 7-1909 and 7-1623.

Interplastics Expands

Interplastics Corporation has moved to new and larger quarters, as announced by Gerald F. Bamberger, President. The new address is 120 East 56th Street, New York 22, N. Y., and the new telephone number is Plaza 1-4280.

Interplastics Corporation supplies a complete line of thermoplastic molding powders, resins and raw materials, both for the domestic and overseas plastics industry. Interplastics Corporation also purchases surplus inventories of molding powders and plastic scrap.

Chemical Building Block

A new chemical building block—glycidyl methacrylate—is being offered in experimental and pilot plant quantities by the Du Pont Company Finishes Division as a convenient way of introducing epoxide groups into vinyl polymers or vinyl groups into condensation polymers.

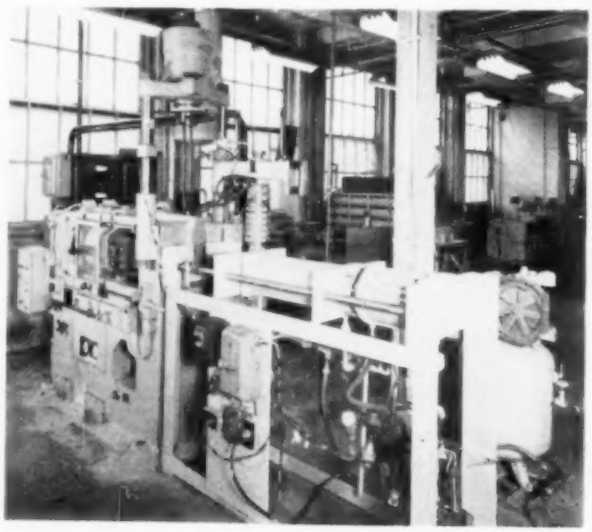
GMA (glycidyl methacrylate) technical data and samples may be obtained from Room 7021-D, Du Pont Company, Wilmington 98, Delaware.

Injection Molding Machine Modified For Thermosetting Plastics

Thermoplastic materials are relatively simple to mold in a continuous cycle by the injection process. Not so with thermosetting plastics. Any continuous supply of material to the mold is limited by the possibility that the material will cure in the system outside the mold—and thus clog the passage to it.

A standard injection molding machine has been modified by engineers in the Westinghouse Materials Engineering Department to permit putty like thermosetting molding compounds to be molded in a continuous automatic cycle. The molding material is contained in a cylinder in sufficient quantity to mold 25 to 50 pieces before recharging. The end of this cylinder is in contact with the hot mold only during the injection period, and sufficient heat is not transferred to the cylinder to set up the material in the cylinder nozzle.

A typical molding cycle, which is timed to run to completion just as a thermoplastic injection cycle, has the following sequence: The safety door of the press is closed, which depresses a switch to actuate a series of cycle timers. These timers control the length of time for (1) closing the mold (2) moving the injection cylinder against the mold sprew (3) injection material into the mold (4) dwell time to permit the sprew to cure (5) retracting the injection cylinder from contact with the hot mold (6) curing time, in addition to that already used, to complete the cure of the piece (7) opening of the mold and ejection of the cured piece. The cycle can be repeated by closing the safety door of the press as many times as the capacity of the injection cylinder permits.



New Nylon Compound

The development of a new and improved polycaprolactam-type nylon compound, Plaskon Nylon 8201, specially formulated for extrusion and blow-molding, has just been announced by Barret Division, Allied Chemical & Dye Corporation.

The new nylon compound represents a number of improvements over previous nylon compounds, Ellis said, thereby extending the range of products that can be fabricated successfully from this material, including clear film and small diameter tubing and rod.

Flame-resistant Epoxy

Stampreg flame-resistant epoxy resin pre-impregnated glass cloth manufactured by Standard Insulation Company, East Rutherford, New Jersey is being used in laminates exhibiting such outstanding electrical characteristics as 83,000,000 megohm centimeters volume resistivity, 25,000,000 megohms surface resistance and 18,000,000 megohms insulation resistance. This material has been engineered primarily for critical electrical and electronic laminates as in printed circuits.

Scrap Granulator

A new plastic scrap granulator, Model G-200, has been introduced by The Van Dorn Iron Works Co., 2685 East 79th St., Cleveland 4, Ohio.

The granulator's alloy steel knives grind all thermoplastics including vinyl and polyethylene without fluffing. Hot and cold sprues can be fed together.

To facilitate cleaning, the hopper chute is hinged and the entire hopper can be removed in a few seconds. The end plate is also hinged so the screen can be readily taken out.

Nylon Tubing Tools

Two new tools for nylon tubing—one a tube cutter and the other a flaring tool — have been announced by The Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.

The new tube cutter is designed to make quick, clean, square cuts and eliminates the difficulties usually experienced when cutting Nylon Tubing, it is stated. It is only necessary to make one or two revolutions of the cutter on the tubing and the tube is cleanly cut off. The possibility of fracturing tubing in cutting is eliminated.

Nicholson Expansion

Nicholson File Company, of Providence, R. I., has purchased the assets of The Danielson Manufacturing Company, of Danielson, Connecticut, makers of molded and extruded Nylon products for industrial use, and has formed a new Rhode Island corporation of the same name. This new Nicholson subsidiary will continue to be operated by its present management.

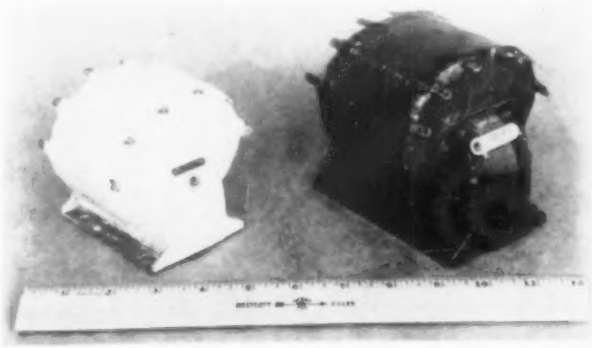
Marken Pipe

Marken Plastics Corp., Los Angeles, well known manufacturer of extruded plastic products and custom extrusions, announces entry into the plastic pipe industry with a full line of both rigid (PVC) and flexible (Polyethylene) pipe and tubing. A complete range of sizes from $\frac{3}{8}$ inch to 4 inches, with all types of fittings will be offered.

New Epon Units

Shell Chemical Corporation today announced the completion of two new Epon resin units at its Houston, Texas, plant that will triple its production of the resins. One of the units will produce liquid grades of the resin and the other solid grades.

Compact Electronic Transformer



Compactness necessary for Westinghouse Electric Corporation's airborne electronic equipment demands small size, with consequent higher operating temperatures. Components must be designed accordingly. This high-temperature electronic transformer (left) is built similar to the previous Fosterite construction (right), but is encapsulated with Dow Corning Silastic silicone rubber and impregnated with a solventless silicone resin developed jointly by the Westinghouse Electric Corporation and Dow Corning.

Men In The News

Ivan E. Welborn has been appointed superintendent of the new formaldehyde and synthetic resin plant being built by the Borden Company's Chemical Division at Fayetteville, N.C. The plant will go into production early next year. Mr. Welborn joined the Division as a control chemist in 1953 and the following year became superintendent of its Kernersville, N.C. plant. His successor at Kernersville is John R. Lowery Jr., who has been with the Division since 1954.

James G. Couch

James G. Couch has been named Manager of the Production Department's Engineering Section, it has been announced by Robert H. Cornwell, Director of Production for U. S. Industrial Chemicals Co., Division of National Distillers Products Corporation.

Mr. Couch will have responsibility for design and construction of new plants as well as the expansion and modification of existing plants of U.S.I. and subsidiary National Petro-Chemicals Corporation.

J. B. Chip

The Board of Directors of Plastic Material Sales, Inc. elected J. B. Chip Vice President in Charge of Sales, as of November 2, 1956. Announcement was made by W. B. Bradbury, President. Plastic Material Sales, Inc. is a subsidiary of Plastic Molders Supply Co., Inc., of Fanwood, New Jersey.

A. T. DeVerra

J. D. Proctor, General Sales Manager of the Celluplastic Corporation of Newark, New Jersey, today announced the appointment of Augustus T. DeVerra, Jr., as Assistant Sales Manager.

Mr. DeVerra joined the Celluplastic Corporation in 1953. Recently, he has been in charge of the metropolitan New York area of the company.

The Celluplastic Corporation is one of the world's leading producers of plastic vials, jars, and custom plastic packages.

John Schmidt

John Schmidt, has been elected vice president in charge of sales for New Plastic Corporation, Los Angeles, Calif., according to J. A. Carmien, president.

A. K. Thorn

A. K. (Ken) Thorn, formerly manager of the American Management Association's packaging division, has been named western regional sales manager for Plax Corporation, Hartford, Conn.

Industrial Literature

Durez Phenolic

Newly published, a pamphlet of the Durez Plastics Division, Hooker Electrochemical Co., North Tonawanda, N.Y., gives complete data and other information on a new medium-impact Durez (R) phenolic molding compound. The material, Durez 13124 Black, has an unusually good molded finish. Its typical applications include instrument cases, machine housings, solenoid housings, transformer covers, automotive switch parts, and the like.

The four-page booklet is file size, and a valuable addition to your plastics literature. Copies may be obtained from Durez Plastics Division, Hooker Electrochemical Co., Walck Road, North Tonawanda, N.Y.

New Plasticizer

A new high-molecular-weight polymeric plasticizer, Emery 3049-S, is described in a booklet offered by Emery Industries, Inc., Cincinnati.

For a copy of the booklet, Technical Bulletin No. 62, titled "Emery 3049-S Polymeric Plasticizer," write Emery Industries, Inc., Dept. 5, Carew Tower, Cincinnati 2, Ohio.

Ethylene Pipe Standards

A Recommended Revision of Dimensions and Tolerances for Flexible Standard-Wall Polyethylene Pipe, Commercial Standard CS197-54, has been presented to the industry for approval, according to the Commodity Standards Division of the U. S. Department of Commerce.

The recommended revision was proposed by the Standing Committee of the Industry. It differs from the current edition of the standard in that, the current edition covered only dimensional requirements, whereas the revision contains some significant specifications for quality. Two additional series of wall thicknesses are also included.

Copies of the recommended revision, entitled Flexible Polyethylene Plastic Pipe, TS-5348, may be obtained, while the supply lasts, by writing to F. W. Reynolds, Commodity Standards Division, U. S. Department of Commerce, Washington 25, D. C.

Hydraulic Valves

Copies of "High Pressure Hydraulic Valves" and information on special valves for custom applications is available without cost from R. D. Wood Co., Public Ledger Bldg., Philadelphia 5, Pa.

Plastic Bearings

PLASTIC ROLLER BEARING RACE SEPARATORS — CRITICAL OPERATING PROPERTIES OF PLASTICS. Dr. A. Gremer, Schweinfurt, Germany. June 1955. Translated by Science Translation Service, University of Alabama, for Bureau of Ships, U. S. Navy. 25 pages. 75 cents. (Order PB 121363 from OTS, U. S. Department of Commerce, Washington 25.) Plastic bearings have been widely substituted for those of metal in German industry because of superior "critical operating properties," defined as the operating behavior of bearing materials under such unfavorable conditions as failure of lubrication, high local loading because of improper installation, and excessive RPMs. The outstanding properties of

Men in the News

Reinhart Honored

Frank W. Reinhart, Chief of the Plastics Section, National Bureau of Standards, received the Meritorious Service Award of the Department of Commerce "for major contributions to the science and technology of plastics, and for highly distinguished authorship" from Secretary Weeks on February 14, 1957. Mr. Reinhart was President of the SPE in 1955.

Schnitzer Appointed

Herbert S. Schnitzer has been appointed to head the newly formed compounding and pilot plant group at DeBell & Richardson, Inc. Other recent additions to the engineering and chemical staff include: W. J. Eakins, specialist in polyesters; E. W. Turner, Chemical Engineer, returned to duty after 2 years with the Armed Forces; H. C. Wain, Mechanical Engineer; F. R. Wixon, Chemical Technologist.

Joseph Rosenberg

A full line of acetate molding powder is now in production according to an announcement made by Joseph Rosenberg, Production Manager of Poly-Cell Plastics Co., Smithtown, New York. He disclosed that initial shipments have already been made and reports from molders attest to this material's superiority for high speed injection molding and extrusion.

Monahan is Manager

Mr. William J. Monahan, formerly of The Dow Chemical Company, has been appointed to the position of Plastics Sales Manager of the Seamco Chemical Company. The production plant and sales offices of Seamco Chemical Company are located at 3 Hanover Street, Holyoke, Massachusetts.

Debing and S.Q.C.

"The Poly Press," Monsanto house organ, pays tribute to Larry Debing, Ed Harrington and Jack Hinchen, for work on SPE's first Technical Volume "Quality Control for Plastics Engineers." The February issue of the magazine devotes half a page to the story and ends with a brief history of the formation and objectives of SPE.

Award To Pribble

Wayne I. Pribble was recently chosen for one of two awards as "Citizen Engineer" at the National Engineers week banquet in Fort Wayne. He was named to this honor for his contributions to engineering and to civic projects, particularly in the area of church work.

He was first president of the Northern Indiana Section of SPE, and has long served on the National Council and as a National Officer of SPE.

W. H. Bennett

W. H. Bennett has been appointed President of The Hydraulic Press Mfg. Co., Mount Gilead, Ohio, a Division of Koehring Company, it was announced by Julien R. Steelman, President of Koehring Company.

Morrisette Up at 3 M

Appointment of Joseph F. Morrisette as sales supervisor for reinforced plastics for the West coast area has been announced by Minnesota Mining & Manufacturing Co.

Morrisette will direct sales and servicing of reinforced plastics manufactured and distributed in the West under the "SCOTCHPLY" trademark. He will headquarter in Los Angeles.

AROUND THE WORLD

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UNITED STATES

ELECTRICAL MANUFACTURING

February, 1957

Abstracter: Bennett Nathanson

SILICONE MATERIALS IN APPLIANCE DESIGN—J. F. Dexter, Dow Corning Corporation

This article reviews specific applications for various silicone-based materials. Silicones (resins, rubber, oils and greases) are pointed out as widely being used in appliances principally because of their superior thermal stability properties over a wide temperature range. Typical applications are fluid lubricants for mechanisms, rubbers for gasketing, wire coverings, laminates and molded parts.

January, 1957

RESIN-EMBEDMENT PROCESS CONTROL FOR OPTIMUM ELECTRONIC PACKAGE DESIGN —Charles A. Harper, Westinghouse Electric Co.

In the embedment, encapsulating and potting of epoxies and polyesters for electronic assemblies, these major tests for determining raw material quality by the process engineer are significant: viscosity measurement; exothermic properties (gel time, time to peak exotherm and peak exotherm;) and hardness. Typical embedment problems with their possible causes and remedies are also reviewed.

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GERMANY

DER PLASTVERARBEITER

December, 1956

Abstracter: Leo Fischer

INSULATION FOR REFRIGERATION IN BREWERIES AND STORE ROOMS—Bellinger

A very fast and economical method of building refrigeration units is described. Blocks of a foamed plastic are built up and cemented and both sides are coated with a cement and sand stucco on the outside and plaster on the inside.

SILK SCREEN PRINTING —Dr. Messerschmitt

A discussion concerning the practicality of silk screen printing in the plastic industry. An outline of various techniques and their applications is given.

A NEW GERMAN SYNTHETIC RUBBER—Buna Works Huls

A new synthetic rubber plant of 45,000 annual tonnage capacity, manufacturing "cold rubber" will be ready in 1958. The polymerization will take place in a 5°C Redox System, using a butadien-styrene emulsion copolymerization. It is claimed that the product will have a thermal build up in actual use no greater than natural rubber.

CHARACTERISTICS AND SPECIFICATIONS OF SYNTHETIC PIPE —H. Gut

Synthetic pipe is discussed in hydraulic, electrical and acoustical applications, where dullness of sound transmitted, high abrasive resistance, no deposit of lime, no destructive effects of static electricity build up are a factor. PVC, high pressure polyethylene, low pressure polyethylene are analyzed and calculations for determining safety factors are given.

CAN POLYAMIDS BE EVALUATED?—Werner Laeis

A thorough analysis of advantages and disadvantages of polyamids. A list and formulations of 11 polyamids made of five different acids is given, showing the differences as well as similarities of the various polyamids produced in USA, Germany, and France.

The conditions which affect various characteristics of polyamids are: number and dispersion of CH_2 and CO-NH groups, length of molecular chain, monomeric residues, the ratio of crystalline and amorphous elements and water absorption.

ALUMINUM POWDER AS PIGMENT FOR SYNTHETICS —Dr. H. Kalpers

It is advised to use aluminum in flake form when incorporated with PVC or other resins. Description of production of aluminum flake is given. It is claimed that Al flakes with silicone resin and butyl titanox has a heat resistance of 600°C. Generally large flakes have a greater heat resistance than small ones.

A NEW PLASTIC MOLDING TECHNIQUE IN METAL CASTING —Dr. H. Kalpers

Shell casting is fully described including patent literature. Principle is to make a sand mold that is removable from pattern in a few minutes, creates a water impervious mold, eliminates surface bubbling and prevents hazards of silicosis in casting operations. A dry resin and hardener poured into the mold is heated to 200°C and poured out in 5 seconds. A removable shell remains. A formula given consists of 93% sand of mesh size .2 mm and 7% phenol resin with 1% hexamethylene tetramine (100 mesh). At the Volkswagen plant a continuous casting operation of 7000 cylinders per day is sustained using per ton of cast metal 8 kg resin and .25 kg silicone grease.

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KUNSTSTOFFE

January, 1957

Abstracter: Anne Schwend

PRODUCTION OF PLASTICS COATED WRAPPING PAPERS —Dr. Gustav Hagen

A discussion of properties that wrapping papers coated with plastics either on one side or on both sides should show, is followed by a description of the kinds of processes used in applying different plastic materials.

HIGH POLYMERS FROM POLYMER OIL-CONTAINING FILM-FORMING MATERIALS AND SUNDRY SYNTHETIC RESINS THROUGH "METALLIC REINFORCEMENT" —Dr. Felix Schlenker

Aside from the well-known processes of molecule increase through polycondensation, polymerization and polyaddition, a novel way of cross-linking is being offered to the high molecular organic chemistry in the form of "metallic reinforcement" which comprises those reactions permitting the transformation of low molecular compounds with potentially

functional groups into macromolecules, active metallic compounds causing the necessary reaction. Such organic metallic compounds, the multivalent metallic atoms which are capable of entering into reaction with potentially functional groups, are designated "active metallic compounds." Depending on the carrier molecule, the position of the functional groups and the conditions of reaction, the following may be considered active metallic compounds: metallic alcoholates particularly in stabilized form, alkoxo salts, metallic phenolates, metal-containing resins as well as salts of bi- or multi-valent metals of materials forming enolic hydroxyl groups and reacting tautomerically as is the case with certain metallic compounds of acetic ester, acetyl acetone, etc.

Functional groups capable of metallic reinforcements are the following: carbon compounds of oxidatively drying binders, carboxylic groups or groups of sour nature such as phenolic or enolic hydroxyl groups or such groups which become sour through desmotropic transformation; further, neutral alcoholic hydroxyl groups. Aluminum alcoholates especially in stabilized form have proven extremely satisfactory among the active metallic compounds and receive special consideration in this article.

Results obtained with this novel process particularly in the field of varnish base materials, give an idea of a new and variable way of bridging the gap between plastics of purely organic and those of inorganic nature.

FLOW TEST FOR PLASTICS COMPOUNDS
—Dr. C. M. Frhr. V. Meysenbug

While the Bakelite Flow Test, ASTM D 569-48 and similar tests are applicable with smoothly flowing compounds such as thermoplastics and thermosets with fine fillers only, the flow-test-apparatus of Messrs. Zwick & Co., Einsingen, W. Germany, described already in Kunststoffe of February 1955, is suited for testing all thermoplastic and thermosetting compounds, from powdery to macerate molding compounds and from thermoplastic granules to pre-polymerized dental compounds into which monomer fluid has been stirred. A brief resume of the characteristics of this apparatus is followed by an evaluation of flow curves obtained with vaious plastics and their importance for the processor.

A PLASTIC HOUSE—DREAM OF TOMORROW?
—Dr. Jh. Saechtling

Report on houses made completely from plastic materials as exhibited by Messrs. R. Camus et Cie., France, and the Monsanto Chemical Co., U.S.A.

THE FORMVAC-AIRSLIP METHOD
—Eng. Patrick Sauter

The Hydrochemie A.G. of Zurich developed a new method eliminating the disadvantages so far inherent to vacuum forming of deep drawn articles with more or less vertical side walls: 1. excessive marginal allowance both increasing cost and reducing number of articles moldable per unit area. 2. Irregular wall thickness. 3. Weak vertical walls due to unilateral stretching of sheeting.

Prompted by the desire to find a means to prevent a blocking of the hot plastic sheeting on the top side of the male mold, hot air was considered a suitable "lubricant" to inflate and bi-axially "pre-form" the film and then, applying vacuum, make this uniformly stretched material slip over the male mold. This method has found ready acceptance for large size parts and plays a decisive role in the packaging field.

MECHANICAL BEHAVIOUR OF SOFT FOAMS
—R. H. Carey and E. A. Rogers

Reprint from Modern Plastics, August 1956.

INJECTION MOLDING OF PLASTICIZED PVC
—Dr. H. Sontag

The principles of injection molding of PVC of varying plasticizer content, chemical reactions of soft PVC, machinery and molds suitable for such processing are discussed.

ROTATIONAL MOLDING OF PVC PASTES
—Graf Helmut Lambsdorff

The features of slush molding of plastigels and plastisols as applied in the United States are discussed.

COOLING OF EXTRUDER SCREWS, WORKING WITH SCREEN PACKS
—Dr. E. Escales

The investigations of the Technical Service of the U.S. Industrial Chemicals Co., New York 16, as to highest output and best surfaces obtainable on extruders with non-cooled screws and inserted screen packs are reviewed.

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KUNSTSTOFF-RUNDSCHAU

January, 1957

Abstracter: Leo Fischer

PETROLEUM AND NATURAL GAS AS SOURCES FOR RAW MATERIALS FOR SYNTHETICS
—Dr. Erich M. Bayer

A very thorough discussion of petrochemistry, yields, formulations, steps in the derivation of various fractions and the dependence of the many plastics on the numerous derivatives. Flow charts in the cracking process are given and the relationship of plastic materials to these fractions.

APPLICATIONS OF PLASTIC PIPE
—Dr. Henry Dahlmann

Plastic pipe has become an important industry in Germany. Over 100 km per month is being produced. Various practical methods of joining plastic pipe to plastic and to metal are described and illustrated. Methods of installation are discussed and shown and many types of expansion joints are illustrated. Tables to calculate thermoexpansion in relation to diameter and length of pipe are given. Rigid vinyl and flexible polyethylene are discussed throughout.

GUIDE FOR CALCULATION FOR INTERNAL COATING OF PIPES
—H. Gut

A formula for calculating shrinkage of polyester coatings in pipes is given. A useful table is included giving the determination of the viscosity and volume of resin required to produce a given thickness of coating.

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HOLLAND
PLASTICA

November, 1956

Abstracter: W. P. ter Horst

PROCESSING OF THERMOPLASTICS . . . . TO BE BACKED BY SCIENCE—J. van Leeuwen

The practical processing research of thermoplastics has reached a stage in which the development of a processing science is necessary. The science of processing must be closely associated with the physics of the processing properties of the material. It may be expected that along this scientific roundabout way general improvements of methods, machines and manipulation will be obtained.

PLASTICS APPLIED TO AGRICULTURE AND HORTICULTURE
—J. O. W. Dugteren

A comparison between glass and polyester protection in horticulture; practical applications.

October, 1956

BLOCK COPOLYMERS—J. Heyboer

The dihydroperoxide, emulsion and ultrasonic decomposition methods for the preparation of block polymers and their turbidometric tetration are described.

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ITALY
POLIPLASTI

Sept.-Oct., 1956

Abstracter: Alfred L. Alk

NEWEST APPLICATIONS OF PVC PIPING

Rigid PVC piping is illustrated and discussed as conduit for potable water

(Please turn to Page 69)

SECTION NEWS

Edited by
Charles P. O'Donnell
Monsanto Chemical Co.
Springfield, Massachusetts

Binghamton

SPE's Newest Section Reports On Foundation and Activities

F. W. Reynolds and L. N. Chellis

In July 1956 a letter survey was sent to approximately fifty different companies within a radius of 75 miles of Binghamton requesting their interest and comments regarding the organization of a SPE Chapter in this area. Their response was enthusiastic and beyond expectations. As a result, a steering committee was formed and the first meeting was held in August —temporary officers were elected and the organizing was underway.

Our first general meeting was held in September, attended by 67 people —Jerry Formo was our main speaker. He outlined the objectives and function of the society as well as their plans for the future.

Meetings were held in October and November attended by 73 and 52 people respectively.

As president of the Binghamton Section and National Councilman, F. W. Reynolds attended the National Conference in St. Louis where he presented our petition for charter to the Council which was approved and the charter was formally presented at the banquet. There were five members from the new chapter attending the conference.

March Meeting

Mr. W. J. Stokes, President, Electromold Corp. spoke at our March meeting.

Mr. George Sinden of the Elox Corp. is scheduled for our April meeting, his subject will be the "Application of Spark Erosion Principle to the Machinery of Mold Cavities and Components," this will be supplemented by a 26-minute colored sound film. Mr. S. Levites, President of Hydro Molding Company will follow with a talk on the application of this principle to mold cavities illustrated by several case histories.

Our final spring meeting in May will be a dinner-dance.

Our secretary's records show 35 members, with 18 applications in process. We hope to increase the membership appreciably during this year.

Houghton February Speaker

The Binghamton Section of SPE held its monthly dinner-meeting on February 26th at the Vestal Steak House.

Our Vice-President, Mr. Emory Slaght presided. Guests were Al Rennie, Daystrom Corp.; Bob Coyne, Consolidated Molded Products; Werner Shink, Ansco Corp.; Bob Skinner, Consolidated Molded Products; Dick Park, Houghton Labs; and Don Wolcott, Houghton Labs.

After a brief business session, Mr. Slaght introduced the speaker, Mr. Russell Houghton of Houghton Laboratories, Olean, New York.

Mr. Houghton discussed epoxies and their applications. He briefly covered the patent situation and the chemistry of the epoxies.

The various available curing systems, including polyfunctional aliphatic amines, aromatic diamines, and organic acids or anhydrides were discussed in detail. The speaker stressed the important role played by the compounder or formulator in tailoring the epoxies for a given application.

The speaker demonstrated the applications by means of samples. Of particular interest to the group were bobbins for precision wire wound resistors, cast slip ring assemblies, three dimensional cast models for photo-elastic analysis, potted coils and transformers, injection cavities for development parts, vacuum forming molds, and a sample rod of polyurethane rubber modified epoxy which retains its flexibility at —90°C.

A spirited question and answer period followed Mr. Houghton's address.

O'Connell in January

The new Binghamton Chapter met at the Vestal Steak House on January 31st. There were 64 members and guests present for the dinner and meeting.

We were pleased to welcome the following guests:

Bob Stroman, Durez Plastics & Chemicals; Joe Healey, Chairman of SPE New Section Development; Bud Town, Reichold Chemicals Co.; Clint Knitz, Spaulding Fibre Co.; Peter Brandes, Buffalo Section; Bernie Wenninger, IBM Corp.; Bill Mitchell, Consolidated Molded Products; Jack Larry, Consolidated Molded Products; Tom McCabe, Consolidated Molded Products; Charles Williams, National Vulcanized Fibre Co.; Frank Rydalek, Consolidated Molded Products.

Our president, Frank Reynolds briefly highlighted the National Technical Conference in St. Louis for members who had not been able to attend.

Mr. Reynolds introduced the speaker, Mr. John O'Connell. Mr. O'Connell is President of Consolidated Molded Products Company in Scranton, Pa. He is Past President and now Chairman of the Board of The Society of the Plastics Industry. His subject was "The Value of a Plastics Trade Organization."

The speaker pointed out that SPI is predominately an organization of small businesses who need the weight and authority that is associated with numbers. Because SPI has, through sound policies, in the past, gained the confidence of the consumer public, this imposes an obligation on SPI to continue to disseminate sound information on plastics.

In closing, Mr. O'Connell stressed that any trade organization's success is determined only by the amount of effort supplied by each individual in the membership.

An interesting question and answer period followed Mr. O'Connell's address.

Section Officers

Officers of the Binghamton Section are: President, F. W. Reynolds, I.B.M.; Vice-President, E. Slaght; Secretary, L. N. Chellis, I.B.M.; Treasurer, J. F. Gwyn; section directors are J. Dew, W. J. Kupfrian, E. A. Aimonetti, O. Farnam.

SECTION NEWS REPORTERS

News reports should be sent to Mr. Charles P. O'Donnell, Monsanto Chemical Co., Springfield, Massachusetts.

Mr. O'Donnell accepted appointment as Section News Editor officially at the start of this year.

News must reach the Section News Editor before the fifth of each month, unless special arrangements have been made for later arrival in compliance with your written request.

Miami Valley

'Operation Understanding'

A. P. Young

The regular monthly meeting of the Miami Valley Section was held March 7, 1957, at the Golden Lamb Hotel, Lebanon, Ohio. The speaker for the evening was Mr. Saul M. Silverstein, and his subject "Operation Understanding."

Mr. Silverstein was, in 1952, a member of a five man team sent to Belgium by the Mutual Security Administration to conduct seminars aimed at increasing productivity in that country. A year later he was one of four American observers at the International Conference on Management (OEEC) in Paris, and was asked to survey progress made by Belgian management since the visit of the 1952 team. In March, 1954, he again visited Belgium as a member of a four man team sent to conduct marketing seminars. In September, 1954, he was a member of the first team to carry the management program beyond western Europe. This team conducted seminars in various parts of Turkey, attended by approximately 250 Turkish industrialists.

Mr. Silverstein is Secretary of the Council for International Progress in Management, which is responsible for recruiting and organizing the work of the management teams sent abroad by our Government. He received BS and MS degrees from Massachusetts Institute of Technology in Chemical Engineering, and taught chemical engineering in the graduate school at MIT. He became Director of the Industrial Research Division of the Boston consulting engineering firm of Bigelow-Kent-Willard. This association brought him into contact with Rogers Corporation, which firm he was asked to join in 1930 as Technical Director. In 1938 he was made Vice President, and eight years later President. His philosophy of labor relations, and the firm's policies and practices in this field have become increasingly well known.

More than one third of the world's population—more than one billion men, women, and children—are still living under conditions which represent little more than the level of animal existence. They are easily influenced by any system which holds out to them a promise of security, whatever evils may be concealed beneath the promises.

The United States has assumed the position that the achievement of economic stability is one of the first steps toward security for all people, and that the first step toward economic stability is an increase in productivity. With this in mind, the U. S. Technical Assistance Program

Saul M. Silverstein

was originally developed under the Marshall Plan.

Under this program, some thirty teams, comprised of 150 managers of American businesses, have visited all of the western European countries, as well as Turkey, Israel, Japan, Chile, and Mexico. The purpose of these visits was to share experiences with managers of businesses in these countries in an effort to increase their productivity.

According to Mr. Silverstein, the emphasis of the many seminars conducted has been placed on general management, production, marketing, and human relations, with the primary emphasis being put on the field of human relations.

Mr. Silverstein points out that managements can do a better job of leading by teaching tolerance and understanding in the areas covering attitudes toward unions, government, taxes, security, and tariffs. He concludes that what we all need is more **understanding.** Management should take the lead in accepting the responsibility for developing this **understanding** at all levels of society.

Newark

Designing Polymers

Robert A. White

Despite severe weather conditions, approximately 65 members and guests attended the regular meeting of the Newark Section on February 13th. In the absence of Bob Hoehn, the meeting was conducted by John Lombardi, vice-president of the section.

Peter Simmonds, newly elected National President, addressed the assembly, speaking briefly of the privilege of serving in this honored position. He also offered his congratulations to the Newark Section on their progressiveness and for their support of S.P.E. activities.

Dr. Frank C. McDrew, of duPont, presented his views on Designing Polymers for use in Plastics. In his dynamic approach to plastics research and development from a chemists viewpoint, Dr. McDrew outlined the important role played by the materials processor.

Shape was declared as being the key to the plastics business, with conversion into the desired shape being the fabricator's function.

The main enemies to the processor were defined as stress influence in flexure, short time and long time at elevated temperature, and moisture. Two outstanding property requirements being flex modulus, the resistance to bending stress, and impact; the latter property requiring test conditions more representative of the end usage of the item.

Engineering properties of plastics are defined by the degree of polymerization, with useful limits of 150 to 10,000. In discussing these properties Dr. McGrew used the Alathon series of resins to show the relationship of the maximum temperature limit, density and molecular wt. spread, presenting a three dimensional view of these relationships by the use of slides.

With a chemical structure change, improvement of one property can also be accompanied by some slight gain in others, when proper control is exercised.

Physical modification can also be of advantage to processors as demonstrated by the grinding of Teflon to a finer particle size, resulting in production of a sheet free from pin holing.

In discussing the "Selection of Pay Off Developments," John M. DeBell of DeBell and Richardson Company stated that in such a fast moving industry a requirement for success is faith in the material or process; that success in one out of every four attempts is a very good average. The application of common sense is one of the most important factors in the development of plastics. This is shown in Dr. Bakeland's use of pressure in the processing of phenolics.

Mr. DeBell cautioned that in every research or development program the critical point is that stage of programming at which the decision is made to proceed with the program or to halt it. Many successful programs were continued in the face of much criticism and adverse pressure.

Slides were shown of the testing of coated fabrics under tear stress in two directions. These tests determined the type of fabric and type of joining to be utilized in a new concept of radome housing. This coated fabric was tailored to shaped sections, joined to form a mushroom shaped housing and inflated at 0.4 pounds of air pressure. This heretofore untried and untested enclosure withstood winds up to 150 M.P.H.

C. Burton Wing and R. Hayes

Rochester

A. Therrien

The photo above shows retiring Rochester Section president C. Burton Wing pass his gavel to R. Hayes, who will serve as president for 1957.

President Hayes predicts continued growth and a program of interesting meetings on topics of major importance to the membership.

Western New England

Industrial Applications of Zytel Nylon

C. P. O'Donnell

Mr. William Wall of E. I. duPont DeNemours & Company was the featured speaker at the February 6 dinner meeting of the Western New England Section. Speaking in the Terrace Dining Room at Bradley Field, Connecticut, Mr. Wall discussed Zytel Nylon after being introduced by the technical chairman, Raymond Mazur of American Cyanamid Company.

Skillfully blending sleight of hand trickery with samples of modern manufacturing in plastics industrial applications, the speaker held the attention of the audience from beginning to end. Flaming handkerchiefs formed into solid billiard balls to underscore his comments on the beginnings of the plastics industry and a rope, knotted, tied and cut by members of the audience demonstrated his remarks on preparing engineering principles. The duPont representative used these effects to discuss present Zytel nylon applications in industry and new research developments.

Mr. Wall, as mechanical consultant for duPont, operates in the area of end-use development applications attempting to find new uses for duPont materials. As these uses are developed his group passes on engineering knowledge on these new materials and works out fabrication processes.

An outstanding example of industrial application was an electrical junction box stuffing tool exhibited by the speaker. Made to Navy specifications, it is used to retain shipboard cables with a watertight seal at junction boxes and is now being installed on Navy ships such as the new Saratoga. It is estimated that it will save 45 tons of dead weight and $60,000 in cost over the old style metal stuffing tool.

Other items on exhibit were sucker rod guides which act as bearings for pump rods in oil wells, extremely intricately molded Dole Valves for automatic washing machines, and many other pieces. One item which particularly interested the audience was a compressor valve gasket for use in cross-country gas line pump stations. Originally using cast iron valves seated against chrome metal (cycling 600 times per minute) these pumps required repairs every few months. The oldest nylon gasket which replaced the metalic combination is still in operation after more than two years of use (600,000,000 cycles).

After a question and answer period and viewing the exhibit samples, the meeting was closed.

On February 20 a plant visitation was carried out at the Hamilton Standard Propeller Division. After having dinner, the visiting group enjoyed an extensive tour of the Hamilton Standard operations and a short movie on jet development.

As had been explained by the section president, Lew Gustafson, this tour was an endeavor to bring the plastics industry into closer relationships with the aircraft industry, a need which seems to be felt strongly on the East Coast. It has been remarked that West Coast plastics and aircraft personnel and industry enjoy an exceedingly close relationship, to the benefit of both. This was a preliminary step by the Section to establish a similar relationship.

Southern

Applications Of Plastisols

R. E. Welch and E. O. Redwine

The regular monthly meeting was held on Monday night, February 18, at the Architects and Engineers Institute building, 230 Spring Street, N.W., Atlanta. The Southern Section will be affiliated with this organization which will offer an excellent future meeting place. SPE members and their guests are cordially invited to visit the Institute and examine the many exhibits on the first floor.

Local SPE President, Thomas H. Hart, conducted the meeting and stressed the need of generating more interest and enthusiasm in companies and qualified engineers, in order to expand the Southern Section.

The program chairman, Jones P. Sipe, introduced the speaker, Samuel F. Rutland, Plant Manager of Flexible Products Company, Marietta, Georgia. Mr. Rutland's talk was entitled "Applications of Plastisols". First, a short history of vinyl dispersion resins was given, followed by a discussion of processing techniques, with samples illustrating each method.

Vinyl plastisols are dispersions of vinyl resin in plasticizer. Stabilizers, fillers, pigments, diluents and other materials are generally added to give specific properties in the end product or to aid in processing. Mr. Rutland emphasized the ease and low cost of processing plastisols into end uses as compared to the other familiar methods of vinyl processing, such as injection molding, extrusion, calendering, etc.

Processes discussed were slush molding, rotational molding, casting, low pressure injection molding, hot and cold dip molding, spray coating, yarn coating, fabric coating and glove dipping. A newer product, vinyl foam, was also discussed and compared to rubber and polyurethane foam.

Mr. Rutland showed excellent samples produced by all the above procedures and answered a multitude of questions.

Seated left to right: Leo Siers, Program & House, Mr. Gillman, President; Harold Wilson, Secretary-Treasurer. Standing left to right: Richard T. Davidson, Past Secretary-Treasurer; Boris V. Korry, National Director; Burton A. Cole, Past President; Robert A. Fulton, Former Director; Bruce J. Stewart, Director, and L. J. Vaupell, Director. These gentlemen are officers of the Pacific Northwest Section.

Pacific Northwest

Preparation of Plastic Foams

Marvin E. Carr

At a recent meeting of the Northwest Section, L. J. Philion of the Boeing Airplane Company gave the following address:

A foamed plastic is an expanded, high molecular weight plastic having a distinct cellular structure, consisting of either unit cells which are hollow spheres, or of interconnected cells. These closed or open cell foam plastics can be either rigid or flexible types which can be foamed-in-place, molded, sprayed, extruded or pre-expanded in sheet form.

The methods and materials used in the preparation of plastic foams are as follows:

1. Whipping in air and setting by heat or catalytic action (Urea—formaldehyde, rubber latex and polyvinyl formal foams).
2. Solution of a gas or a volatile solvent which is expanded under reduced pressure and/or increased temperature (cellulose acetate, polystyrene and vinyl foams).
3. Steam produced by a highly exothermic condensation type of polymerization reaction which bubbles as the resin sets (phenolic and epoxy-phenolic foams).
4. Carbon dioxide is given off in an isocyanate condensation reaction (urethane foams-rigid, semi-rigid and flexible).
5. Evolution of an inert gas from thermal decomposition of an organic "blowing agent" (flexible vinyl, silicone, epoxy and rubber based foams).
6. Use of phenolic, clay, urea—formaldehyde, sodium silicate and glass microballoons with a resinous binder system to form syntactic foams.

The properties of the basic resins generally limit the physical, electrical and mechanical properties of the foam structure. The properties which make certain plastic foams suitable for aircraft applications are: light weight, ranging from 0.5 to 40 pounds per cubic foot, high strength-to-weight ratios, excellent electrical properties over a wide frequency range, low thermal conductivities and good energy absorbing characteristics.

Although foam plastics are still in their early stage of development and design data is far from being complete, Boeing has made use of foam plastics either in sheet or foam-in-place forms to solve many unique and entirely satisfactory aircraft applications. In order to qualify for a specific applications, military and AMS specification together with operational requirements are all considered before prototype parts are fabricated.

If the prototype part performs satisfactorily, a construction procedure is written to permit the production of the part. Beside using a foam with the necessary properties such process information as foaming pressures, reproducibility, toxicity and handling time is also considered. In foaming-in-place operations, there is a vast gulf between making a good foam in the laboratory and making a good foam repetitively in production.

Research for and evaluations of new foam plastics as they are developed are in progress at Boeing Airplane Company in an effort to achieve improvements in temperature resistance, adhesion, electrical characteristics and thermal insulting properties. It is anticipated that foam plastics will be used increasingly in future aircraft designs for weight saving in electrical potting, thermal insulation, vibration dampening and foam reinforcement of bonded structures.

Baltimore-Washington

Reinforced Plastics Fabrication Methods

William C. Rainer

Seventy members and guests heard Bob Brinkema, technical vice president of Firmaline Products Inc., speak on "New Fabrication Methods in Reinforced Plastics" at the February 12 meeting at Friendship International Airport.

Matched metal molding, plastic dies, and premix compounding were discussed. In keeping with his informal and practical presentation Bob kneaded in his hands a premix compound, which was on display, and commented on an audience query that it was composed of 20% polyester resin and catalyst, 15% sissal fiber (or glass fiber), and 65% clay. Such compound is molded at 200 p.s.i. ¼ inch is preferred over ½ inch fiber.

Mr. Brinkema also pointed out that steel dies are invariably preferred over plastic dies whenever the economics of the situation allows.

A huge chlorinator housing, made with epoxy tooling, was on display, and its fabrication described. Other items on display were: instrument doors, battery box, religious statue, dinner tray for air line service, spool trays for magnetic wire for interplant shipment etc.

Jim Davidson, executive secretary of SPE, attended the meeting.

Frank Reinhart, National Councilman, gave a report on the status of the national organization. Bernie Achhammer and Al Lightbody discussed the next big event of the section, which is the First Annual Technical Forum to be held on Wednesday March 13, 1957 at the Naval Ordnance Laboratory, White Oak, Md. Admission will be by advance registration only.

President Clare Milton adjourned the meeting.

Southern California

Colored Pigments for Plastics

John A. Stahmann

The Southern California Section met at Scully's Restaurant in March for a program on "Colored Pigments for Plastics." About eighty members and guests were in attendance.

Dr. J. B. Callaway, the principal speaker, is the West Coast Sales Manager for E. I. DuPont de Nemours & Company in the Pigments Department. His talk was principally based on a paper presented to the American Chemical Society by Wormald and Spengeman in 1952 and various technical bulletins from DuPont.

He briefly discussed the chemical and physical properties of synthetic pigment colors as they apply to coloration of plastics, particularly polyvinyl chloride plasticized film. This review employed the usual method of division of synthetic pigment colors into inorganic and organic pigments.

The inorganic pigment group consists of lead chromates, lead molybdates, iron blues, iron oxides, chrome oxide, cadmium reds, cadmium yellows, and ultramarine blue. Emphasis was placed on the importance of the lead chromate and lead molybdate colors because of their ease of dispersion, brightness, low cost, high tinting strength, opacity and wide color range. Their limitations with respect to alkali resistance and blackening with sulfides were noted.

Organic pigments are usually classified into azo and non-azo types. Limitations of the pigment dyestuff class because of their greater or less solubility were stated. However, there are exceptions such as the Pyrazolones and Hansa Yellows that have been used successfully in the plastics field. In the precipitated azo class the metals commonly used were pointed out, such as, barium, calcium, and manganese. The well known pigments in this group, the Red 2B, BON, etc., were also described.

The phthalocyanine blue and green pigments represent the best level of resistance properties of all the synthetically produced pigment colors. These substances are taken as standards for comparison in these respects.

Exhibits were shown of representative pigment colors and blends in plasticized vinyl chloride polymer films. Ratings of bleeding, migration, crocking, lightfastness, and heat stability for the various colors were made. Also displayed were exhibits of some pigment colors in polyester films and in polyurethane foams. It was emphasized that in these two applications, because of the many variables, it is necessary to test pigments in any given formulation.

February Meeting

The evening's program started with the presentation of plaques and overnight cases to Messrs. Paul Erskine, Harold Dague, and Bill Dewar, our retiring directors. This was followed by reports on the national convention. Particular interest was displayed in the discussion of a national meeting in Los Angeles.

Jack Bissell, Chief Engineer for the Horace Blackman Company, started his talk with the startling fact that the sheet-forming industry increased productivity from two million pounds in 1954 to fifty million pounds in 1956.

The fabrication of sheet material into useful articles can be accomplished by three techniques:

1) Vacuum Forming
2) Plug and Ring Forming
3) Positive (Matched Metal) Forming

The first technique, vacuum forming, has the advantage of low costs in tooling, design change, equipment, maintenance, and molds. Such thermoplastic materials as styrene, polyethylene, polyvinyl acetates, and butyrates can be used. Briefly, the thermoplastic sheet is clamped over a female cavity mold and heated by a bank of wire elements or infra red bulbs. When heated, it is pulled down over the die, or the mold is pushed through. The vacuum pulls the sheet into the proper contour. Articles can be enclosed within the sheeting by this method, giving a "bubble pack."

The second technique discussed was the plug and ring system. Slip forming, stretch forming, snapback, and snapback with vacuum are types included. It is similar to metal drawing. With the aid of pneumatic presses, an air ballast is used to keep equal pressures over the entire stroke.

A third technique, the positive or match metal type, makes use of special thermosetting materials. A phenol-formaldehyde with paper, linen, or canvas filler is typical. The postformed laminate can then be trimmed with a radial saw or pin router.

Toledo

New Low Pressure Linear Polyethylene

F. B. Rosenberger

The Toledo Section's meeting on January 23 featured a Monsanto "twin bill" in the form of their movie "The World That Nature Forgot" together with a discussion of low pressure linear polyethylene.

In addition to the above fine program, the meeting was marked by the inauguration of the 1957 slate of new officers and directors. These included: Robert Dunham, President; Bert Gogel, Vice President; Robert Lowery, Treasurer and Elmer Faber, Secretary. James Hyland, Robert Lowery and Bert Gogel were the newly elected directors.

Stanley Melvin, of the Monsanto Technical Service Department, Springfield, Mass., was assisted in the above program by Mr. Don Kocher and Mr. Ken MacIsaac, local area representatives for Monsanto.

The Monsanto film, "The World that Nature Forgot", proved to be a very attractive full-color film which depicted in layman's language a general story of the major categories of plastics and at the same time emphasized their derivation from many and various natural resources.

Mr. Melvin prefaced his discussion of the new linear, high-density type polyethylenes with a resume of the early history and subsequent rapid growth of the conventional low density, high pressure type materials.

In a general market prediction, the speaker stated that despite the substantial production capacity now being built for high density materials, it was the general consensus that such polyethylene would amount to no more than 25-35% of the total polyethylene production for a period of at least several years. The opinion was also expressed that the high density materials would, at least in the foreseeable future, have an end-use breakdown generally similar to the low density material with the largest use category continuing to be film and sheeting and with packaging being the dominant use in this category.

Mr. Melvin, by means of slides, showed many charts comparing the physical properties of the high and low density materials. It was pointed out that as the degree of linearity increases there is a proportional increase in density, heat resistance, stiffness, gloss, tensile strength, hardness, abrasion resistance and impermeability. However, under such conditions of increasing linearity and density there will be a deterioration in flexibility, impact strength and brittleness.

In addition to the pronounced effect which density has on the above physical properties, Mr. Melvin discussed at some length the effect of molecular weight (melt index) and molecular weight distribution on the performance of the high density polyethylenes with respect to cycle time, cylinder temperature and injection pressures in standard molding operations.

Kansas City

Educational Seminar For Purchasers

K. A. Kaufmann

The Kansas City Section held its regular monthly meeting March 4 at Milleman's Restaurant on the Country Club Plaza. This was the first of a two meeting educational seminar entitled "Introduction to Plastics" designed for purchasing agents and engineers from companies in Greater Kansas City which use plastics. All speakers were members of the local section. Attendance was just under 75. Unfortunately, due to travel difficulties two of the speakers were unable to return to Kansas City in time for the meeting. Their presentations will be included in the second session of the seminar although brief summaries of their topics were given at this session by substitute speakers.

Phil Fleming of Bendix Aviation and President of the section presented an extremely interesting introduction: "What are Plastics." He distinguished between thermoplastic and thermosetting resins by explanation, demonstration and examples. Numerous samples were displayed and the heat softening and shaping principle of thermoplastics was illustrated with a cigarette lighter. The distinctive odor upon burning test was also demonstrated and a dramatic foam in place experiment conducted.

Mr. Carl Bontemps of Rohm & Haas presented the story of the injection molding process, describing how and why it works and where it is used. He described the types of end products usually made, the materials used, machine capacities and economic considerations.

Mr. Fred Sutro of Spencer told about compression molding. He related the history of the process; its similarity to, and differences from, injection molding. Mr. Sutro explained plunger molding transfer, semi-positive, low pressure, contact and bag molding; and the types of materials and products associated with each.

Mr. Charles Kucher, Spencer Chemical Company, talked about extrusion. He explained the process and the various uses of extruders with the required process modifications. Typical products, relative cost savings and market potential were discussed.

Mr. Bill Short of Regal Plastics explained fabrication methods generally employing fibre glass lamination, shaping and assembly. Finished items, such as suitcases, were displayed and the various plastics and methods of fabrication for them were pointed out and discussed. Strength and cost advantages were touched upon and range of end uses related.

K. A. Kaufmann was moderator of this session and following the talks a short question and answer session was conducted with the speakers acting as a panel. All who attended felt that the seminar was very worthwhile and indications were that an even larger attendance may be expected next time.

In part II of the seminar, to be held April 4 at the same location, more detailed presentations of injection and compression molding will be given along with individual talks on cellulosics, vinyls, styrene, acrylics, nylons, polyethylenes, and thermosetting plastics.

February Meeting

The Kansas City Section held its regular monthly meeting February 5 at Milleman's Restaurant on the Country Club Plaza. The featured speaker of the evening was Ken Hayes of the Taylor Fibre Company, Norristown, Pennsylvania on the subject of general applications of industrial laminates.

Mr. Hayes outlined the typical production procedures for sheets, rods, tubes and channels of industrial laminates as typified by Taylor's products and including maximum sizes available. In detailing structural make up of such materials he outlined the high strength properties of melamineglass, the high temperature resistance of silicones, the high strength and low moisture pick-up of glass-epoxies and the general properties of paper, canvas and glass phenolics. The various end uses, advantages and limitations of each were discussed.

Various fabrication methods, such as punching, drilling and milling were explained in the light of optimum efficiency. Cost and weight saving aspects of the various materials were pointed out in comparison with other fabrication materials such as metals.

In the March & April meetings of the section an ambitious program is underway under the joint auspices of the Educational and Program committees. It is entitled "INTRODUCTION TO PLASTICS" and over 100 purchasing agents and engineers from the greater Kansas City area are invited to attend. The aims of the program are:

a.) To acquaint purchasing, engineering and other interested personnel with basic PLASTICS information and to increase the prospective use of plastics by their respective concerns.

b.) To promote interest from prospective members.

c.) To provide participation in section activities by a larger group of members.

Both meetings are regular dinner meetings of the Section. Free literature, including The Modern Plastics Properties Chart and Primer of Plastics section will be given to the guests. The meetings take two hours and every speaker is a member of the section. The programs follow:

First Session

A. Introduction; "What are Plastics", P. G. Fleming, President SPE

B. Processes in Utilization of Plastics

1. Injection Molding Process, J. E. Ferguson, Avsco, Inc.
2. Compression Molding Process, C. M. Moore, C. M. Moore Company
3. Extrusion Process, C. G. Kucher, Spencer Chemical Company
4. Fabrication, Bill Short, Regal Plastics Company

Second Session

A. Introduction; Categories of Plastic Materials, P. G. Fleming, President SPE

B. Thermoplastics

1. Acetates, W. P. Gideon, Eastman Chemical Products Company
2. Vinyls, Alan Donaldson, Bakelite Company
3. Styrene, Howard Hamilton, Monsanto Chemical Company
4. Acrylic, Carl Bontemps, Rohm & Haas
5. Nylon, Robert Thomson, DuPont Corporation
6. Polyethylene, Kenneth A. Kaufmann, Spencer Chemical Company

C. Thermoset Plastics, George Roach, Holiday Plastics

Initial plans for these meetings were laid by last year's educational and program committees, headed by Millard Davidson and George Roach and these have combined with the new committees headed by Bob Thomson and George Heflin respectively. The thorough planning of these groups should result in complete success for this ambitious undertaking for a section now only two years old.

R. I. and S. E. Mass.

Automatic Injection

Glenn A. Tanner

The R. I. S. E. M. Section experienced an almost record turnout at their February meeting at Wayland Manor in Providence, R. I. to hear L. A. Ulmschneider from Eastman Kodak. Sixty-six members attended the social hour and dinner but, by the time President Sydney Lohman of Lester Phenix, called the meeting to order, nearly 80 people had gathered to hear the feature speaker. Mr. Ulmschneider first presented a 30 minute film showing the automatic injection operation at Kodak Park. This film dealt with details on the construction of molds for automatic operation and the importance of this mold construction. It also went into

the various safety devices which Eastman has included on its machines and the conveyor system by which parts are carried to the operator for inspection, sorting, and packing. It showed one operator handling the production from 3 machines, with ease.

After the film, L. A. Ulmschneider spoke briefly and answered numerous questions on this type of operation. He brought out that it is not necessary to have any specially designed equipment for this purpose, but only an injection machine, which is capable of continued operation without down time, as well as the ability to produce uniform cycles. The real secret of automatic molding lies not in the machine, but in the mold design.

More thought must be given to construction of molds for automatic operation. 99.9 percent operation is not sufficiently good. To have a piece stick once in a half hour period, is more costly than the expense of correcting the mold. The molds, he stated, must be capable of running without down time.

He particularly pointed out that the type of ejection from the mold must be fool proof. To obtain this, he has found that it is often better to perfect the simple methods rather than to increase the complications with added gadgetry.

He prefers the use of knock-out sleeves in preference to knock-out pins or stripper plates. The use of knock-out pins often offers a projection on which pieces from above can catch. Similarly, he much prefers allowing pieces to fall free rather than using any complicated ejection fingers. On automatic molding, it is more important, than in normal production, to have the nozzle opening the correct size for your shot, the nozzle spacing correct, the runner system and the gates correctly sized. These features must be analyzed and tested in advance, but the time spent doing so will reap high dividends in smooth and even production.

The machines at Eastman are well protected with safety devices for all contingencies. The strain rods have strain gauges to measure the pressure applied and these are used to give standard settings for each mold. To assure that these devices are offering constant protection, they are tested and inspected every 4 hours.

L. A. Ulmschneider made a specific point that he does not believe in working to the maximum capacity of any piece of machinery or equipment. In his 8 oz. injection machines, about the largest shot they use is 5-3/4 oz. Since the machine is never working to capacity, parts breakage and maintenance is kept to an absolute minimum. As an example of proof of his thinking in this regard, as well as in mold design, he cited an instance where one of their molds had run constantly, 24 hours a day, 6 days a week, for 2-½ years with but 5 hours down time. Even though this might be the best performance in their plant to date, it is still an excellent example of what can be done with correct planning.

New York

New Method of Producing Preforms For Reinforced Plastics Parts

Malcolm W. Riley

A new mechanized method of producing preforms for reinforced plastics parts was described at the February 27 meeting of the Reinforced Plastics Group of the New York Section at Tufaro's Restaurant in Corona, L. I. S. H. A. Young, executive vice president of the Pressurform Container Corp., Swarthmore, Pa., described the technique which promises to permit economical mass production of reinforced plastics parts.

The four major advantages of the process are: (1) permits variable thicknesses in design of parts, (2) provides a high degree of uniformity of quality from part to part, (3) permits high speed production of preforms, and (4) provides mechanization of the entire preform production process.

Essentially the Pressurform process is similar to pulp molding. Water and reinforcing fiber, such as glass and cotton, are automatically fed in controllable proportions to a tank in which they are agitated to form a slurry of even consistency. The slurry is then metered into the mold cavity in the preforming press. The mold consists of perforated male and female members. After the slurry is charged to the mold, the lower mold member moves up against the upper member, compressing the fibers in the slurry and squeezing out the water. Closing pressures are on the order of 50 to 200 psi. After the preform is compressed to the desired density, the mold opens, the preform is automatically ejected, and a new batch of slurry is metered into the mold cavity. The ejected wet preform is then moved to a drying oven. The finished preform can then be used in standard matched metal molding. Total preforming cycle is about 55 seconds.

Most development work to date has been carried out on mixtures of glass and cotton fibers; 80% glass, 20% cotton being about the optimum ratio. Parts have been made with as high as 95% glass; however, addition of cotton improves impact strength. Other types of reinforcing fibers can be used in varying combinations.

Preforms produced by the process are highly uniform in density. Weight deviations from preform to preform are no higher than 2%. This permits accurate control of resin-reinforcement ratios in subsequent moldings. The high degree of reproducibility is the result of the mechanization of the process, which reduces human error to a minimum. In past production runs, Mr. Young claims, rejection rates have been less than 0.5%.

Since the process is designed for large quantity production, tooling is relatively costly. However, costs average only about 30 to 70% of those for matched metal molds. Minimum runs which would justify tooling for the Pressurform process depend on individual designs.

Design limitations are as yet not clearly determined. According to Mr. Young, the only limits on maximum variation of section thickness, or maximum depth of draw, exist in the equipment available.

New look at an old process

The other speaker of the evening was William F. Turner, manager of sales service for the Polyester Resins Division of Reichold Chemicals Inc., White Plains, N. Y. Mr. Turner summarized the Flowform method of fabricating reinforced plastics parts, pointing out the potential of the process for parts in prototype and developmental quantities.

This process, in use for many years, consists of laying up reinforcing mats or cloth in the female mold, pouring a predetermined quantity of resin, and inserting the male plug to the desired depth. As the plug is inserted, the resin rises in the mold, wetting the fabric, and driving out any air entrapped in the resin. The major feature of the method is that inexpensive wooden molds can be used, reducing costs on short run parts. Gel coats can be used on both female and male mold members. Molding cycles range from 1 to 25 min for room temperature curing resins, depending on size of part. The process is particularly suitable for production of dome shaped parts such as radomes.

A. J. DeMatteo Appointed

Farrel-Birmingham Company, Inc., Ansonia, Connecticut, has announced the appointment of Adolphe J. De Matteo as General Manager of the Company's Watson-Stillman Press Division, Roselle, New Jersey.

Detroit

Effect of Good Design on Business

Mac Nichols

The Detroit Section of the SPE held its monthly dinner meeting at Dearborn Inn on February 18th and approximately 50 members and guests were privileged to hear Carl Sundberg of the industrial designing firm of Sundberg and Ferar discuss "The Effect of Good Design on our Economy."

In his talk, Mr. Sundberg, who is a charter member of the Detroit Section, dwelt at length on the broad application of plastics in the modern designer's horizon. He stated that there is an ever increasing demand by the public for newness and originality.

"It is the job of the designer," declared Mr. Sundberg, "to dramatize the efforts of the engineer and to originate products that fully meet the discriminating requirements of the electronic and atomic age."

"It is the essence of good designing to never go overboard," continued Mr. Sundberg, "but to maintain a balance with conservatism."

One of the most common faults in designing is to rely solely on tradition when developing a new product. The most desired and subtle method is to create a new article wherein the buyer does not know that he is being influenced by style.

This new concept in product design has made its presence felt in the current trend in household products, office machines, furniture, toys and automobiles. Each year more and more new items are being introduced and present articles are being redesigned to embrace color harmony with eye pleasing contours so that attractiveness as well as operating efficiency can be offered to the public. Any article produced that has been properly engineered and designed will sell itself.

Mr. Sundberg gave detailed accounts of many items that his firm had been called upon to create and showed where there was a definite correlation between dollar volume in sales and good design. He concluded his lecture with a series of colored slides depicting an array of futuristic projects and items that had been prototyped under his direction, many of which have already taken a prominent place in our present day economy.

Upper Midwest

Mylar Properties and Applications

W. W. Everling

Forty-nine members heard Mr. James C. Couturier of E. I. duPont deNemours & Company, speak about the miracle film "Mylar". Acting in the capacity as duPont's area representative for industrial film, Mr. Couturier presented his talk along with a film entitled "What's It To You?". Samples of Mylar as currently used in various applications were passed among the members.

Mr. Couturier noted that Mylar, an oriented polyester film, has high tensile strength, exceptional tear resistance, and high impact strength. It is remarkably stable between -80° and +300°F. Chemically Mylar is unaffected by greases, oils, acids, alkalies, methanol, acetone, carbon tetrachloride, ethyl acetate or electrical varnishes. Mylar displays high dielectric strength, low power factor, as well as high volume and surface resistivity. Prolonged contact with phenols and creosols tend to cause a breakdown in material. Severe hydrolysis will cause brittleness. These factors prevent the use of Mylar for insulating material in closed or sealed systems.

Mylar can be metallized, embossed, fabricated, stamped or die-cut, printed, silk screened, and can be bonded to wood, metal cloth, paper leather and plastics. It is used in the bookbinding and shoe industries, as furniture covering material and in such electrical items as capacitors, coils and electric motors. It is used in the home for wall covering, furniture covering and for drapes. It is used in fabrics for casual and dress wear, as well as for upholstering in vehicles of transportation. Mylar is used in ropes, cables, wire coating, and vapor barriers in home and industrial insulation.

Since Mylar does not contain any plasticizers it offers good resistance to weathering. Mr. Couturier noted that his company supplies Mylar as a clear transparent film in thicknesses running from .00025 to .0075 inches. Its extreme strength combined with clarity and light weight make this material a highly desirable packaging material. While heat sealing of Mylar is impractical or impossible, it was stated that adhesives are available for bonding of the film to itself. In this manner sky-hook type balloons have been fabricated.

Mr. Couturier noted that while Mylar is still relatively new to the public its exceptional properties combined with its versatility of application is leading to virtual unlimited end uses. New ideas for its use are continually evolving and it promises to be a material about which much will be heard.

Eastern New England

New Officers

Charles P. Pechulis

Officers of the Eastern New England Section for 1957 are: president, David Towler, M. W. Kellogg Co.; vice president, William Nissen, Bakelite Corp.; treasurer, Robert Ward, Improved Machinery, Inc.; secretary, George Kovack, Foster-Grant Co.

Board of Directors members are as follows: Three Year Term, Joseph Clancy, Emery Industries, Gim P. Fong, Raytheon Mfg. Co., Alfred I. Simon, Raytheon Mfg. Co; Two Year Term, William Nissen, George Kovack, Robert Ward; One Year Term, David Towler, Josiah D. Crosby, Hood Rubber Co., Prof. Albert G. H. Dietz, M. I. T.

Committee Chairmen are: Ralph L. Mondano, Raytheon Mfg. Co.—Professional Activities; Gim P. Fong—Membership Committee; Frederick P. Quartarone—Credentials Committee; Joseph P. Clancy—Program Committee; James P. Truitt, Sylvania Elec. Co.—House Committee; Charles P. Pechulis, Northern Industrial Chemical Co.—Publicity Committee; Prof. Russel W. Ehlers, Lowell Technological Institute—Education; William L. Root, Raytheon Mfg. Co.—Election Inspectors; Robert S. Ward, Finance and Auditing.

Healey Joins Standard Tool

Joseph P. Healey has joined Standard Tool Co., Leominster, Mass., to accept a newly created position as general sales engineer.

Maintaining a base of operations in Buffalo, N. Y., Mr. Healey will cover all areas of the United States except the New England and metropolitan New York territories for the Massachusetts concern, supplier of machinery and equipment for the plastics and rubber fields and other industries since 1911.

During Mr. Healey's tenure as vice president and sales manager of Manco Products, Inc., Melvindale, Mich., he supervised the preparation of a manual regarded as the first authoritative handbook on the fabrication of beryllium copper components and their uses in molding, die casting, and stamping. He also pioneered in developing and perfecting proper applications of these materials, and it is anticipated that he will perform a similar function in his new position.

SPE Regional Conference

"Plastics for Electronics"

The New England Sections of the Society of Plastics Engineers will hold their first one-day technical session on Friday, June 14, 1957 at Lowell Technological Institute, Lowell, Massachusetts. Plans are set to have this New England One-Day Technical Session an annual event. The topic for this year will be "Plastics for Electronics."

This symposium will be of particular interest to all manufacturers and producers of plastics and to the electronics industry as well as to small manufacturers of electronic components. Of exceptional interest to the manufacturers will be an opportunity for them to gain an insight into the plastic needs of the electronics industry, and to pose pertinent questions to an assembly of experts.

The papers will be selected from the following list of subjects:

Dielectric Insulation
Potting, Encapsulating & Impregnating
Fluorocarbons in Electronics
Housings for Electronic Equipment & Components
Reinforced Plastics for Radomes & Reflectors
Silicones in Electronics
Plastics for Printed Circuits
Artificial Dielectrics
Conductive Plastics for Electronics
Plastic Specifications for Electronics

This conference is being jointly sponsored by the following New England Sections:

Connecticut
Eastern New England (Host Section)
Pioneer Valley
Rhode Island and Southeastern Massachusetts
Western New England

Further information may be had by writing to the General Chairman, Ralph L. Mondano, Raytheon Mfg. Co., Seyon St., Waltham 54, Mass.

Ships to Plastics . . .

(Continued from page 46)

Taking Grace's experience in ammonia, for instance, we know that increased sales are making a positive offset to the declining unit profitability curve. While Polymer Chemicals Division will not be making high density polyethylene until later this year, we have followed the same reasoning in projecting the picture for this new product. We assume a modest profitability picture for the new polyethylene; however, our long range thinking tells us that we want to be in on the future for plastics, as the fastest growth segment of the chemical industry, and that this is a good place to start. New technological advances in plastics that can be advantageously adopted won't just come along some rainy Thursday if we are on the outside looking in. It is much better to be a functioning and, we hope, efficient team that can assimilate the growth in polymer chemistry that research is sure to bring.

Our opinion that plastics are the fastest growing segment in the chemical industry seems to be shared by most of the major chemical firms in the U. S. and abroad including the major petroleum processors.

You have to search quite far to see a major chemical producer who is not closely tied to the plastics industry. Even the mightiest holdouts have succumbed in recent years and one well-known firm has announced plans for expansion in the last few months that will make them important factors in this industry.

The reason for this is that plastics are showing dynamic growth in the chemical industry, and any expansion-minded firm, as a matter of course, must be regularly running market research and commercial chemical development studies to analyse how they will best fit into the changing picture.

Not only is there a similarity in sounds between the engine room of our Grace Line ships and the production plants for our own fertilizers and chemicals. Later on this year, we look forward to the possibility of seeing bags of polyethylene molding pellets shipped throughout the U. S. by truck and rail service and by ship to plastic fabricators in Latin America. Grace Line cargo ships, of course!

The Condensed Chemical Dictionary.

Fifth edition, revised by Arthur and Elizabeth Rose. 1200 pages. Reinhold Publishing Corp., New York, 1956.

This 5th edition of the Dictionary previously directed by Francis M. Turner has been revised and enlarged. It is thumb-indexed and contains over 30,000 entries in double column pages. Formulae, chemical and physical properties of chemicals and raw materials are listed first, then their uses and other valuable data. Generic names such as aliphats, Geons, pigments are fully defined and described.

A great many trade names are also listed, and this will greatly help the reader, since many new chemicals having a complicated formula are described by their manufacturers and known by their users under more convenient pseudonyms. Others known by numbers are found in a special category: "Nos" at the end of the book, for instance 606 and 1080. This part is too short however, and many others should be included. For instance, one can find 2, 4 d: 1) only if one remembers that its chemical name is dichlorophenoxyacetic acid, 2) after a one line listing on page 370 refers to its actual description under 2, 4 D at the beginning of D listings on page 337. A single mention in the Nos chapter would make it easier to the peruser. This remark applies to several other number-known chemicals.

There are a few omissions as can be expected in a book of this type. However, these criticisms made with a constructive purpose do not diminish the value of the Condensed Chemical Dictionary, since perfection is not human. We believe, on the contrary, that this excellent book belongs on the desk of every chemist and scholar and that it will obtain in the chemical field the success their authors justly deserve.

Louis C. Barail

1956 Supplement to Book of A.S.T.M. Standards, Including Tentatives, Part 5, 320 pages. Published by A.S.T.M., 1916 Race St., Philadelphia, Pa.

This supplement covers fuels, petroleum, aromatic hydrocarbons and engine antifreezes.

Dual Thermocouples . . .

(Continued from Page 44)

and sound principle. In the past, installations have been made incorporating in some cases a separate shallow thermocouple well, and essentially duplicating the thermocouple installation on each individual zone. A new design of surface thermocouple has been developed by our company to make this installation much easier for existing equipment, requiring only minutes to install on a machine and also permitting the installation to be made at an approximate cost for the additional thermocouple of about four dollars a zone. Figure 10 shows the completed assembly as installed in a block of steel which might represent a portion of the wall of the machine.

Figure 11 shows the conventional spring-loaded type of thermocouple removed from the assembly. Notice that the surface thermocouple remains in place. The surface thermocouple is a copper ring with the thermocouple welded to it, and this ring is held in place by a lock nut installed on the conventional adaptor used for bayonet type thermocouples.

The exploded view of the parts involved (Figure 12) illustrates how this is applied to a machine. The additional part required for equipment in service is the surface thermocouple and lock nut, which is available with either a $\frac{3}{8}$"-24 internal thread for use on adaptors of this type or with a $\frac{1}{8}$"-27 thread which will fit a $\frac{1}{8}$ pipe tap threaded adaptor.

The installation of dual thermocouples on equipment will improve its operation under normal conditions and will in no way compromise present performance. As indicated, the installation may be accomplished readily at a nominal cost and it has the effect of adding to present instrumentation rate action, which, in itself, if designed into instruments, would represent a cost equivalent to the cost of the existing pyrometer controller alone. One will at all times be assured of closer temperature tolerance, and most important, will be assured of returning to normal operation faster should the temperature at any time deviate from the desired temperature as set on the control instrument. It is hoped that molders and extruders will incorporate this equipment into existing machinery in the interest of improved temperature control.

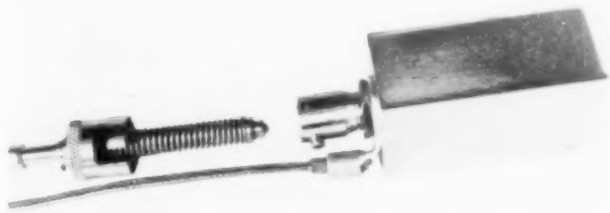

Figure 11. Thermocouple removed from assembly

Figure 12. Exploded view of parts

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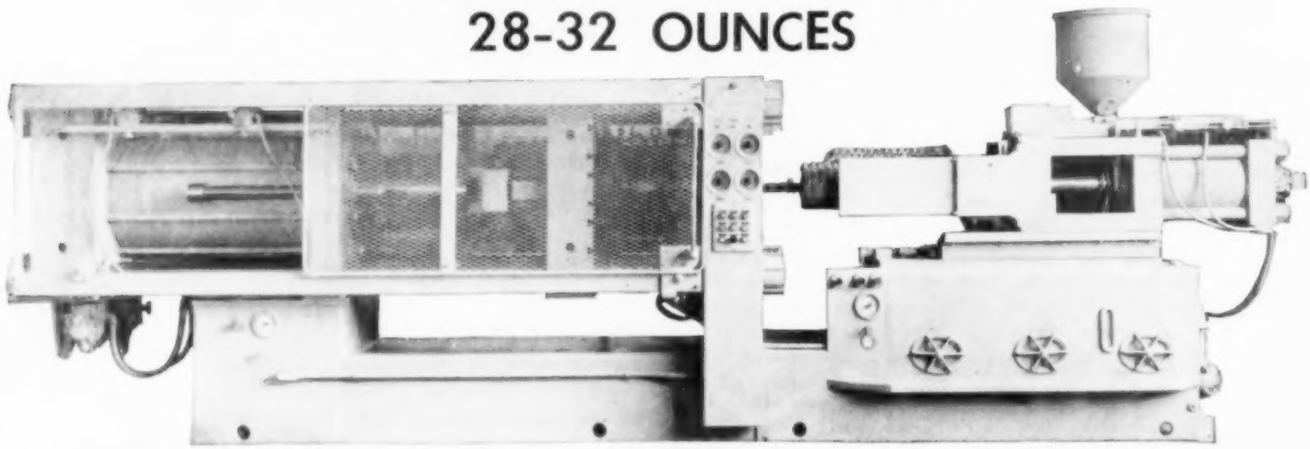
28-32 OUNCES



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NASHUA IMPCO NEW HAMPSHIRE

(Cont'd from page 58)

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A 50 ton motor vessel, launched in May, capable of 50-55 mph will replace a ferry plying between Sicily and Calabria. The vessel, which reduces the length of voyage from 35 to only 5 minutes, has many plastic components and represents the culmination of 20 years development.

PROGRESS IN THE AREA OF PRESSES FOR PLASTICS
—A Triulzi
A description of the presses produced for the plastics and metal working industries. Injection and compression equipment, in various sizes, laminating presses, multi-plated equipment and special presses are illustrated and described.

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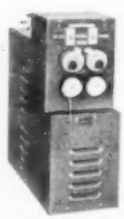

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Glass-Flake . . .

(from Page 37)

higher than commercial laminate #2. Especially interesting is the Tan δ or the mechanical dissipation factor. This figure shows that the flake laminate can absorb nearly twice as much energy as either of the other two laminates. In more common terms, this shows that if an energy absorption test such as the Izod impact strength were run, the flake laminate should be quite superior. This has not been confirmed by actual impact tests to date.

It has been proposed that the plate-like construction with each plate being reinforced by other plates should make these materials superior from the viewpoint of penetration. Whether the penetration is attempted by such common agents as ultra violet light or by bullets, resistance should be better. However, only fragmentary data have been obtained so far.

I will now briefly touch upon our future plans. First and foremost, we are interested in studying the variables due to the flake. To this end, Emhart has been awarded a contract to make glass flake.

An experimental procedure has proven to be moderately successful but the equipment did not allow reaching the steady state. Enlarged equipment is now being constructed. It is hoped that this will produce flake which is flatter and stronger than presently available flake. It is also anticipated that if the equipment performs as expected, flexibility of operation will be greater than commercial production and the study of such variables as flake thickness, area to thickness ratio, and like variables can be studied more readily.

It is also believed that the proposed method of making flake will allow the application of finish and/or resin to nascent glass surfaces. By spraying on the resin it is believed that resin layers of one-two microns may be achieved. It was mentioned earlier that flake laminates were superior in mechanical properties to the molding compounds available. If the resin can be applied to the flake in the forming stage and held at the B stage, it may be possible to produce a better molding compound. Since molding compounds are, in general, more uniform than products which are produced by hand lay-up methods, the big bug-a-boo of non-uniformity may be greatly reduced. It should be stressed that the work under this contract is of a research and development nature and while the method proposed appears feasible, it must still be proven.

In addition to the Emhart contract, it is anticipated that a second contract will be let by the Ordnance Corps. This second contractor has not been chosen but the desired area of work would be the improvement of the mechanical properties of flake laminate. Optimum constructions and improved fabrication techniques will be studied to exploit to the fullest the properties inherent in flake glass.

To summarize, it has been demonstrated that a flake glass laminate can be made. While these laminates are not superior in all properties, they are acceptable for some applications in their present stage of development and are quite superior in some aspects. The aspects which are most striking are the extreme stiffness, energy absorption ability, and economy of this type of construction. Room for improvement exists and can reasonably be expected. The Ordnance Corps, through local and contract work, will endeavor to fulfill these expectations.

The author wishes to acknowledge the work done by Armour Research Institute, Emhart Manufacturing Company and Linden Laboratories.

Pioneer Valley

Kovach Talk On Plastic Sheeting

Jack Perkins

The Pioneer Valley Section of the Society of Plastics Engineers was honored to have as its guest speaker George P. Kovach of the Foster Grant Company, Inc. at its February 14 meeting held at the Wachusett Country Club, West Boylston, Massachusetts.

The topic for the evening was "The Present and Future Prospects of the Plastic Sheeting and Sheet-forming Business."

Beginning with a brief history of sheet-forming methods, Mr. Kovach pointed out how better, faster, and cheaper processes developed through the years have contributed a great deal to the growth of the plastic sheeting industry. The introduction of new materials gave way to new uses for plastic sheet, particularly in the vacuum forming of large area parts too expensive for injection molding.

A review of the new materials from the vinyls to modified styrenes, linear polyethylene and nylon pointed up some interesting prospects on the new applications for these materials. Film and extruded sheets from these varied materials have found their way into many new industries in the recent past. It is anticipated that the automotive, airplane, decorative and toy industries will use large quantities of film and sheeting in the years ahead.

The packaging industry has been a particularly fertile field for sheeting and film. The tremendous growth of prepackaging in food stores in recent years has been responsible for the consumption of large quantities of polyethylene and other type of film.

Victory Mfg. Expands

Continuing business expansion is reflected in two new executive appointments just announced by Edward Singer, President, Victory Manufacturing Corporation, Chicago plastics molder.

Harold L. Samuels has been named Victory's Executive Vice President. Mr. Samuels was for 12 years administrative officer of Doehler-Jarvis Corp. and most recently was with Chicago Molded Products Co. as a member of their executive committee.

Edward F. Abbott, Victory's General Manager for the past few years has also been appointed a Vice President.

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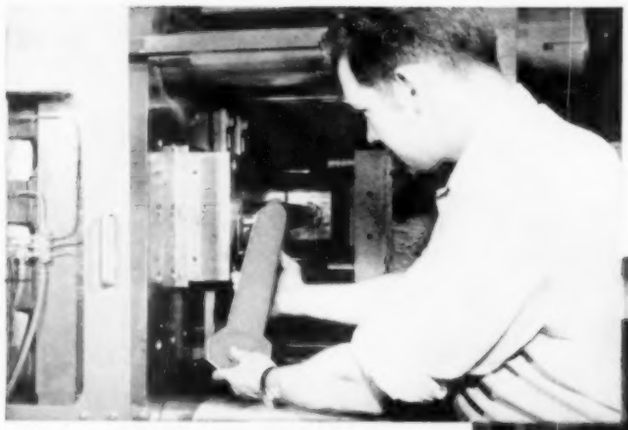

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